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THE COVERS: When you live in the Rocky Mountain region, it is not unusual for a sultry summer afternoon to be punctuated by "Flash & Fury in the Sky"—lightning. The front cover photo by Tim Lucas, a student at Western Montana College in Dillon, illustrates the beauty of this fascinating, but potentially dangerous, natural phenomenon. To understand the whys behind the fury, turn to Don Fuquay's article on page 2. In July, the thoughts of many recreationists focus on water, particularly on fly-fishing in such waters as the Big Hole River. Shirley Cleary's back cover was done in gouache, an opaque watercolor technique. For her, as for writer Roderick Haig-Brown, "...fishing is...only an excuse to be near rivers...."

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Overview

The Maasai, a nomadic, cattle-herding tribe of the East African plains, have a number of proverbs that reflect their outlook on life. One of them, translated into English, says simply, "Things change."

True to the proverb, things have changed for the Maasai. Proud, powerful warriors, feared and respected by all around them, they once roamed the plains at will. Young warriors achieved status by their exploits in battle and by bravery in killing the lions that molested their cattle. Killing lions is dangerous work, even with a high-powered rifle. The Maasai used hand-made spears.

Today, the Maasai no longer kill lions, although it has been only a few decades since they stopped. They stopped because the number of lions has dwindled in East Africa, and those that remain are protected by law. The Maasai, of course, who lived harmoniously (if not peaceably) with the lion for centuries, had nothing to do with the king of beast's demise. Sweeping political, economic and cultural changes—changes that a handful of tribesmen were powerless to resist—led to the depletion of East Africa's once-magnificent wildlife, including the African lion.

The hills of East Africa are still green, and Mount Kilimanjaro still rises majestically above the plains of Amboseli. And the Maasai still herd their cattle in the great mountain's shadow. But something has gone out of their existence, for the lion was more than just an animal to the Maasai—it was a symbol of strength, speed and courage, an important part of their heritage and culture. To conduct themselves with dignity—in their words, "to walk like a lion"—has become more and more difficult in recent years. In a recent *Audubon* article Peter Matthiessen reported that even the traditional dress of the Maasai is now condemned by the socialist government of Tanzania as too "uncivilized."

Changes are coming to Montana, too. But we have one important advantage over the Maasai: We have the wherewithal to control these changes, to direct them into positive channels, and to see that our way of life isn't threatened by them. The natural resources that set Montana apart—things like the Bob Marshall Wilderness, the grizzly bear, the Yellowstone River, the Arctic grayling and the bald eagle—are as important to Montana's heritage and culture as the lion was to the Maasai's. They are more than just places, animals, rivers, fishes and birds. They symbolize freedom for people to hunt, fish and roam in wild and untamed country, and the opportunity to enjoy landscapes that remain substantially unchanged. Without them, Montana would still have its snow-capped peaks, its rolling grasslands and its Big Sky sunsets, but it wouldn't really be Montana.

Some of the changes affecting Montana's outdoor environment are detailed in this issue of *Montana Outdoors.* Ron Marcoux points out that river floating has increased tremendously in popularity, and that it is no longer easy to find solitude on many of the state's rivers. Studies have shown that a bank fisherman on the Madison, Montana's most heavily used river, may be passed by as many as 60 boats in an eight-hour period!

Other changes have affected individual species, such as the Arctic grayling. Norm Peterson warns that the stream-dwelling form of the grayling is in trouble in Montana, primarily due to competition from exotics, fishing pressure, habitat changes and the grayling's lack of genetic adaptability. He recommends special recognition and management for the stream-dwelling form of this magnificent fish to help it in its battle for survival.

Eastern Montana, too, is seeing far-reaching changes in the wake of coal mining and energy development. Russ Penkal traces the life history of the sauger, a good-tasting sport fish closely related to the walleye. His research shows that while sauger inhabit the lower 350 miles of the Yellowstone River, from Billings to the North Dakota border, they spawn primarily in the Tongue and Powder rivers. Without adequate instream flows in these tributaries, the entire sauger population in the Yellowstone could be jeopardized.

As the Maasai proverb says, "Things change." We can't do anything about that, and perhaps it's just as well. But *how* things change is, to a large degree, up to us. Let's see to it that we keep our outdoor heritage intact.—*Dave Books, editor*

Flash & Fury in the Sky

by Don Fuquay

IN THE Rocky Mountain region, summer afternoons are often punctuated by sudden thundershowers and brilliant lightning flashes. While lightning is a beautiful, and in some respects a beneficial, natural phenomenon, it also poses a serious threat to people, animals and property. Every year it is responsible for structural damage, fires, power outages and numerous deaths and injuries. Part of the problem is that many people don't understand lightning and fail to take the proper safety precautions during thunderstorms.

How Lightning is Generated

On a typical thunderstorm day, the small cumulus clouds that form near

noontime continue to build during early afternoon. As they grow higher, they begin to resemble gigantic cauliflowers, their tops appearing hard and bright. Inside, condensation of water vapor causes large drops and ice particles to form. When these particles become large enough, they fall through the updrafts and eventually emerge as rain. The falling water and ice particles, by processes not yet fully understood, cause a negative electrical charge to accumulate in the lower part of the cloud and a positive charge to accumulate in the upper part.

These charge centers within the developing storm set the stage for the onset of lightning in the following

City dwellers are ordinarily safe from lightning, mostly due to the sheltering effect of tall buildings and grounded power lines (left photo: Tony C. Caprio). Positive and negative electrical charges, which build in thunderclouds like those above, set the stage for lightning (photo: Don Fuquay).

manner: The negative charge in the cloud base attracts a large positive charge in the conducting earth below the cloud. This ground charge grows with the strength of the cloud's negative charge and faithfully follows the cloud as it moves over the ground. Picture this positive charge flowing to the upper limits of hills, rocks, buildings or people—anything that conducts electricity and is closer to the cloud. The charges, attracted by million-volt electric fields, strive to break down the electrical resistance of the intervening air. When this resistance is finally overcome, a lightning bolt results.

Lightning can span the distance between the charge centers within the cloud or between the negatively charged lower portion of the cloud and the positively charged earth. Let's look at the latter occurrence, since this is the one that does all the damage. The discharge usually begins with a downward-moving spark, called a *stepped leader*, traveling in a series of luminous steps about 50 yards long toward the ground. This negatively charged leader prepares an ionized, electrical conducting path to the ground. It may follow a tortuous path, sending out branches to the side to intercept small pockets of positive charges along its course. As it nears ground, the electrical stress between the leader tip and surface protrusions increases until streamers reach up toward the leader, much like a cobra rising to the snake charmer's flute. The first of these streamers to contact the downward-moving leader determines the strike point. As soon as contact is made, a surge of current creates a luminous channel propagating back up the leader path and out the channel branches. The leader has made its descent in 20 to 30 thousandths of a second, and the return stroke lasts only a few millionths of a second. Additional return strokes may follow at intervals of 30 to 40 thousandths of a second. In some cases, the return stroke may develop a continuing current "tail" that lasts for several tenths of a second at a low current level. These continuing current tails, much like a welder's arc, cause major damage at the contact point, including explosions and fire. The leader and return strokes usually happen so fast that the eye detects only a single flash of light. Most lightning flashes are over in the blink of an eye.

Thunder is produced by the lightning return stroke. The return stroke current follows a channel less than an inch in diameter, within which the temperature may reach 50,000°F. The sudden temperature rise causes a rapid expansion of the channel gasses, creating a sound wave radiating outward at roughly 1,000 feet per second, or one mile in five seconds. Since we see the flash of the discharge at the instant it occurs, the time that elapses until we hear thunder gives us an estimate of the distance to the strike point. For instance, a thunder delay of 15 seconds would indicate the lightning was about three miles away.

How Lightning is Conducted

We have seen how the thunderstorm develops and how lightning starts toward ground. Now let's consider how lightning behaves as it makes contact. When the lightning channel nears the ground, connecting streamers reach upward from the tips of grounded objects. The first streamer to make contact, called a connecting leader, completes the electrical circuit and receives the surge of lightning current. A connecting leader from a lightning rod can easily reach out and intercept lightning falling within a distance of about twice the rod height above ground. Thus, a lightning rod, tower or building gives a "cone of protection" of about a 60-degree angle from its top. Within this space, the lightning will be drawn to the rod.

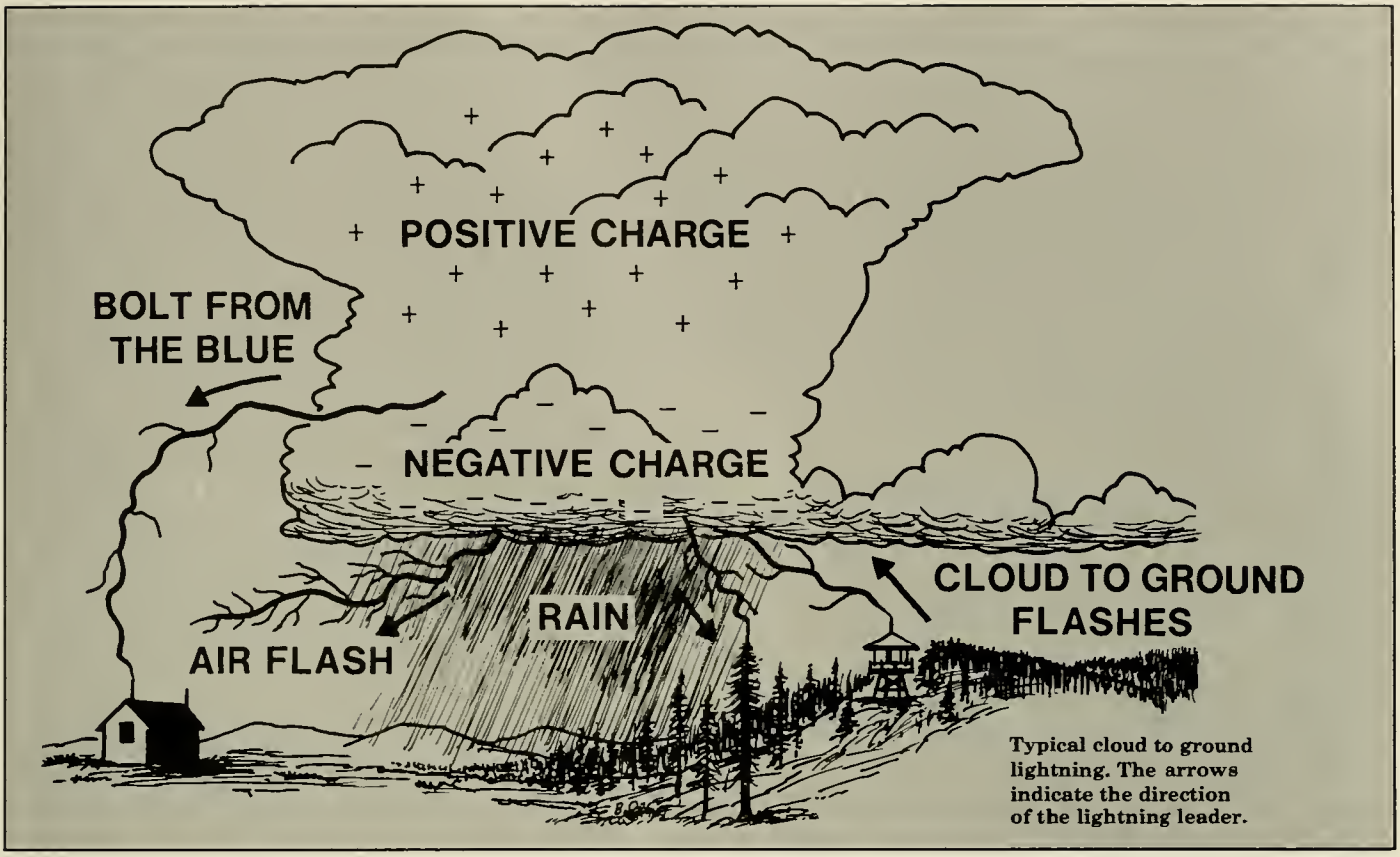
What happens if the lightning just hits the ground or a tree? The current will invariably choose the path of least resistance to neutralize its charge. Although concentrated in the earth directly beneath the cloud, the bound positive charge may extend miles in all directions. One can visualize numerous paths that the lightning current might take depending on the nature of the surface. Moist soil is a good lightning conductor. If the earth at the contact point is very dry or rocky, the lightning current may travel along the surface or flash into the air for several tens of feet. If the strike is to a tree or an unprotected wood building, the wood may be shattered and ignited. A lightning strike to a dry, rocky slope can produce very unusual behavior. The lightning current may travel along the surface much like a sheet of water pouring down a steep slope, following channels and crevices, splashing over and around blocks and cascading across voids in the rocks only to disappear into a moist crevasse.

The human body and most animals are good conductors of electricity. Not as good as a copper rod or wire, but better than air, wood, rock or dry soil. Humans and animals show varying responses to an electric current, depending on its path through the body, the amount, and how long it lasts. Relatively small currents passing through the brain stem and downward along the spinal column cause respiratory arrest. Current through the chest causes circulatory arrest and heart fibrillation. A modest current through the lower torso or across the legs can cause muscle spasms and temporary paralysis of the lower body. Large currents flowing through the limbs can result in serious burns without causing loss of critical body functions. Animals respond similarly to humans. Neither retain any residual electrical charge after the current has stopped and present no danger to someone moving close to give assistance.

How Lightning Strikes

How can we apply this knowledge of lightning behavior and body responses to personal safety? First, consider the four ways that lightning currents reach the body: The *direct strike* occurs when the body becomes the lightning conductor—literally, a lightning rod. This happens when lightning strikes a tractor driver in an open field, a golfer on the green, a fisherman standing in a boat, or a climber on an isolated point. The injuries received are invariably fatal. Chances for survival are better when the body carries only an initial streamer but not the full force of the discharge. When lightning strikes a group of people, one or two will often be killed while others are only stunned or temporarily paralyzed.

Contact voltage enters the body when there is direct contact with the conductor carrying the lightning current. Any conductor carrying a current develops a voltage difference along its surface proportional to the



Typical cloud to ground lightning. The arrows indicate the direction of the lightning leader.

current surge. A person touching the conductor will have part of the current diverted through him and on to ground. This could happen to a person leaning on a metal fence or touching a plumbing fixture when lightning hits. A farmer handling irrigation pipe might experience a contact voltage or a direct strike depending on how close the lightning hit.

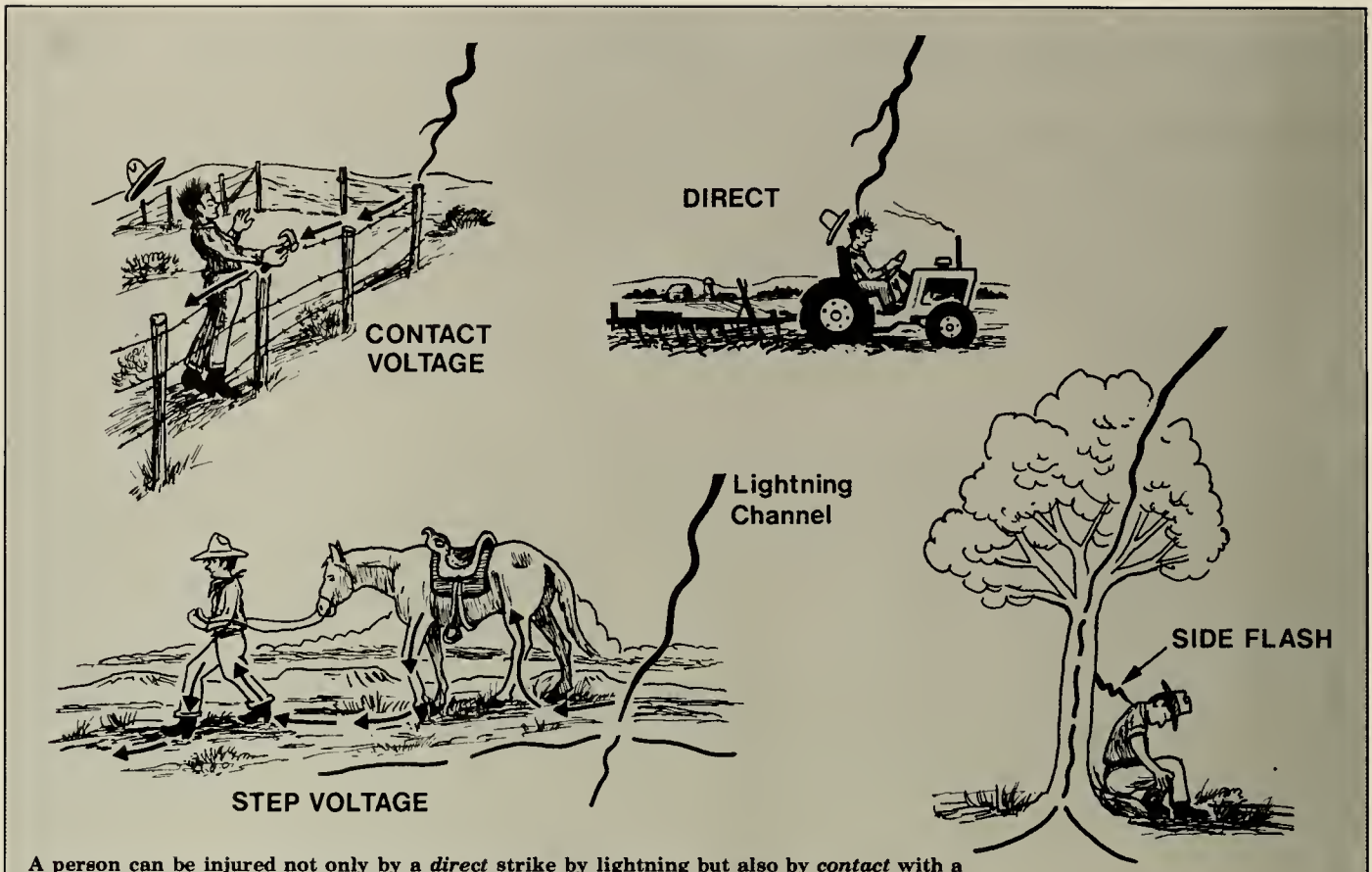
The *side flash* is a particularly devious form of lightning behavior because it is difficult to predict. It happens when a pulse of current within a conductor generates sufficient voltage to send a spark jumping across as much as one to two feet of air and then through an alternate conductor to the ground. People standing close to anything carrying the lightning current are particularly vulnerable. It could happen when standing or sitting close to a struck tree, a piece of construction equipment, the side of a house, or near a stove with a metal smoke pipe. There are many other possibilities. Lightning surging through the electrical system in a house can explosively spark from wiring within the walls or from nearby electrical appliances. Rural telephone lines can carry a lightning-induced voltage that leaps from handset to an ear or face. There are many reported incidences of side flashes from tent poles to tent occupants.

Step voltage is similar to contact voltage except that the voltage difference is along the ground near the lightning strike point. Electric current through the ground can produce high step voltages even several hundred feet away from the contact point. In dry soil, the spark may flash-over into the air. Visualize the many ways that the body could be affected. A person walking or standing with legs apart could receive a paralyzing jolt through the lower body. Much serious physical injury comes from falls following a paralyzing shock. Postures with both hands and legs touching the ground could lead current through the torso. A person prone in a damp sleeping bag could receive current along the length of the body. Step voltage can be avoided by limiting contact points with the ground. A crouching or kneeling position with limbs close together is recommended. Crouching on an insulated surface, such as a coiled climber's nylon rope or a dry knapsack, will also help.

Large animals are very vulnerable to step voltage both because of their length and the position of the organs within the body. Groups of cattle, elk, sheep and horses have been killed by this type of current. There are many stories of cowboys in the saddle being struck by lightning, with the horse killed and the rider uninjured. We can guess that the horse was a victim of a step voltage. To even the score, there are also cases where the rider is the victim and the horse survives. Occasionally, both are killed.

Lightning Deaths and Injuries

Records of lightning accidents give us some clues about risky situations. We know the records are not complete because casualties from such things as house and wildland fires, munition and oil tanker explosions and aircraft disasters are not recorded as lightning fatalities or injuries, even though they are lightning-caused. Also, lightning accidents usually involve only one to three individuals and receive only local media coverage. Once in awhile, however, lightning draws national interest. For example, millions of people were listening when the Apollo 12 space vehicle triggered two lightning



A person can be injured not only by a *direct* strike by lightning but also by *contact* with a conductor carrying the lightning current, a *side flash* from a struck object or by a *step voltage* from current passing along the ground from a nearby strike.

flashes during launch which cut out the on-board computer and guidance systems. Airline crashes in Florida and Maryland have been attributed to lightning. More recently, a lightning flash caused the emergency shutdown of a Michigan nuclear plant even though no damage was reported.

Statistics indicate that the risk of being struck by lightning is closely related to the living and working habits or recreational activities of the individual. There is little chance of being injured by lightning in a modern home or building. City dwellers are particularly safe, mostly due to the tall buildings and sheltering effect of steel frame construction and grounded power lines. Still, using home appliances or touching water pipes when lightning is near should be avoided.

The risk is higher around nonurban houses, barns and sheds with inadequate lightning protection. Unprotected rural buildings and haystacks are quite vulnerable to lightning-ignited fires. One category of rural accident stands out because it could be easily prevented: telephone-related incidents, which make up about 4% of all lightning deaths and a higher percentage of injuries. The long rural party lines, strung above ground, are especially vulnerable to a direct strike. To be safe, stay off the phone during thunderstorms, except for emergencies.

Statistics show lightning casualties are divided about evenly between people engaged in work and in recreational activities. Also, most accidents occur in early afternoon during June, July and August. Of the people engaged in work, farmers and ranchers make up about 30% of the casualties. Among recreationists, boaters, fishermen, swimmers, golfers, campers and picnickers head the list.

Perhaps more revealing are the situations in which lightning casualties occur. Five categories, in descending order of importance, are: "under trees," "open water," "tractors," "golf course" and "telephone." About one-third of the people killed while standing under trees (usually isolated trees) were golfing at the time. The "open water" category includes people swimming and those on or near beaches, on piers or levees or in small boats. The "tractor" group includes farm tractors and implements, construction equipment, cars and trucks. The "golf" group includes only golfers who did not fit in the "under tree" category. The last group, "telephone" was mentioned earlier.

The foregoing statistics, which demonstrate that most lightning accidents occur in open areas—fields, water, golf courses, etc.—attest to one fundamental rule: "Don't be a lightning rod." The tallest object in the immediate area is the object most likely to be struck. Tall, isolated trees are especially hazardous; if better shelter is not available, move to a uniform grove or to an area with brushy growth above head height.

While many people are killed by lightning each year, the records show that more than two-thirds of the

continued on page 24

The Catchall

Meet the Commissioners and the Director

Pictured are members of the Montana Fish and Game Commission and the director of the Montana Department of Fish, Wildlife and Parks. The following sketches provide a bit of information about each.

Earl L. Sherron (left, seated) is the commission's vice chairman. He operates Earl's Distributing in Missoula and is affiliated with several civic and fraternal groups, including the Missoula Chamber of Commerce, University of Montana Century Club and Elks. Sherron was appointed to the commission in May 1978 by former Gov. Thomas L. Judge. He was reappointed by Gov. Ted Schwinden in January 1981 and his term runs until Jan. 7, 1985.

Spencer S. Hegstad (middle, seated) is the commission's chairman. He manages the Sears store in Dillon. He has been active in Jaycees and was secretary of the Montana Jaycees in 1969 and vice president in 1971. Former Gov. Judge appointed Hegstad to the commission in April 1976 and reappointed him in 1979; his term runs until Jan. 1, 1983.

Department of Fish, Wildlife and Parks Director **Jim Flynn** (right, seated) has owned and operated disposal businesses in Anaconda and Dillon, served in the Montana House of Representatives and worked from 1974 to 1980 on the governor's staff in various positions—legislative coordinator, administrative assistant, special assistant and executive assistant. Flynn assumed the director's duties in January of this year.

Dan Oakland (left, standing) of Great Falls is a sales representative for Northwestern National Life Insurance Company. He is active in Ducks Unlimited and many other civic, fraternal and professional organizations in Great Falls. He was appointed to the commission in January by Gov. Schwinden; his term runs until Jan. 1, 1985.

Don Bailey (middle, standing) operates the family ranch south of Forsyth where he raises purebred herefords and commercial feeder cattle. A past chairman of the Rosebud-Treasure Wildlife Federation, he has been a member of the group for over 20 years. He also served on the department's Landowner Relations/Sportsmen Access Advisory Council. He was appointed to the commission by Gov. Schwinden in January and his term runs through Jan. 7, 1985.

Paul Tihista (right, standing) operates a lumber yard in Glasgow. He is active in Elks, Lions, the Democratic party and the Fort Peck Game Range Committee. Former Gov. Judge appointed Tihista to the commission in August 1979, with his term ending Jan. 1, 1983.

Recreation Survey Results Available

"Given the choice, would you rather catch *more* fish or would you rather catch *fewer* but *larger* fish?" "How would you feel about giving private landowners some kind of financial incentive for maintaining wildlife habitat and allowing access?" "What is your general feeling about how well the state maintains its parks and recreation sites?" These and many other questions about outdoor recreation formed the basis for a comprehensive outdoor recreation survey, and the results are now available. The subject will also be addressed in a major article scheduled for the Sept./Oct. 1981 issue of *Montana Outdoors.*

Conducted during summer 1980 by the University of Montana's Bureau of Business and Economic Research, the recently published survey results include information of considerable interest to anyone concerned about outdoor recreation in Montana.

Copies of the entire "Montana Outdoor Recreation Survey" are available for $3.50 per copy to cover printing and postage from the Conservation Education Division, Department of Fish, Wildlife and Parks, 1420 E. Sixth St.; Helena, MT 59620.

Wilderness Group Sponsors Walks

The Montana Wilderness Association is again sponsoring a Wilderness Study Walks Program. This year's program will focus on specific threatened roadless areas in Montana, and the association will attempt to enlist public support for those areas through the study walks program.

Leaders are experienced outdoor

RECYCLED PAPER

recreationists and members of the association. They donate their time to help acquaint others with Montana's wild lands. Since there is no charge for service included in the walks, participants are asked to provide their own transportation, food, and equipment.

Although several of the walks have already taken place, many are scheduled for July, August and early September—for example, Ramshorn Peak near Gardiner, Sphinx Mountain near Ennis and West Big Hole near Jackson. Many of the trips require reservations. For additional information, contact the Montana Wilderness Association, P.O. Box 635; Helena, MT 59624 (406/442-0597).

Tribute to Joe Halterman

Joe Halterman, at one time a warden with the Department of Fish and Game and later a career fisheries biologist with the U.S. Fish and Wildlife Service, died on Jan. 19, 1981, at age 67. A Missoula native, he earned a bachelor's degree in biology from the University of Montana. After joining the department, he held assignments in Condon and Roundup. Following a stint with the Third Infantry Division in World War II, during which he saw front-line combat in Europe, he returned to Montana and earned a master's degree in wildlife biology. Shortly thereafter, he received an assignment with the U.S. Fish and Wildlife Service in Billings, where he worked until he retired in 1965.

An avid outdoorsman and dedicated conservationist, Mr. Halterman was an active member of the Montana Wilderness Association, the Montana Wildlife Federation, and several other conservation organizations. A member of the Blue Ribbon Rivers Commission, he played an instrumental role in developing the blue ribbon classification scheme for Montana's rivers and streams. His foresight and dedication were important in the struggle to preserve the Yellowstone as a free-flowing river.

Mr. Halterman's family asks that donations be sent either to the Montana Wilderness Association, where a special fund has been established in his name, or to the Missoula County Cancer Society.

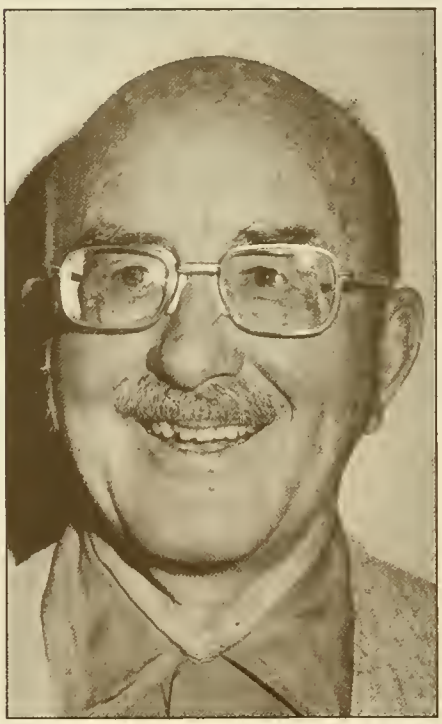
Correction

• We would like to correct some statistics that appeared on page 36 of the article, "Tips for Wood Gatherers," in our Sept./Oct. 1980 issue. Instead of saying that "...1.6 million board feet of firewood—or the equivalent of 7 million barrels of oil," it should have said the 1.6 million board feet of firewood is equivalent to approximately 9,440 barrels of oil.—*Ed.*

The Wildlife Society Honors Faye Couey

The Montana Chapter of The Wildlife Society, an organization comprising about 150 wildlife professionals in the state, has presented its Distinguished Service Award to pioneering game biologist Faye Couey of Kalispell.

Couey was one of Montana's first game biologists. With degrees from the University of Montana and the University of Wisconsin, he began working for the Department of Fish and Game in



Faye Couey (photo: Wayne Arnst, Great Falls Tribune)

1941. He was responsible for some of the first upland bird surveys conducted along north central Montana's Hi-Line. From 1942 to 1944, he prepared a comprehensive survey of bighorn sheep in Montana; his results appeared in the popular 1950 publication, "Rocky Mountain Bighorn Sheep of Montana." Between 1944 and 1946, Couey was in charge of surveying antelope in eastern Montana, and was among the first to use aerial surveys.

From 1946 to 1957, he worked for the department in Helena and managed the wildlife land acquisition program using money generated by the excise tax on arms and ammunition (Pittman-Robertson funds). Lands purchased under his supervision included Freezout Lake, Ninepipe and Blackfoot-Clearwater Wildlife Management areas and the Sun River Game Range.

Couey was assigned to the Region 1 headquarters in Kalispell as the game manager in 1957. He held the position until retiring in 1969.

He and his wife, Evelyn, continue to live in the Flathead Valley. Couey remains active as a part-time teacher, trapper and trumpet player.

Nongame Update

Why are ferruginous hawks restricted in Montana? What are the common denominators between the Beaverhead County and Carter County ferruginous hawk breeding areas? What is happening to our western bluebird?

These questions, and many more like them, are subjects for Montana's nongame program—a program designed to address the needs of some 435 species of vertebrate wildlife, plus mollusks and crustaceans.

The federal Endangered Species Act of 1973 covers only those species listed as endangered or threatened. However, the Montana Nongame and Endangered Species Conservation Act of 1973 calls for conservation of *all* nongame species. Within the framework of this legislation, the Department of Fish, Wildlife and Parks established a nongame and endangered species resource program. The primary goal is to assure perpetuation of Montana's diverse nongame species. Specific activities include gathering information and attempting to determine occurrence, distribution, density and population status for nongame species, providing suggestions to enhance a species' status or suggesting how to reduce an adverse effect.

Not all species classified as nongame are scheduled for study, but about 75 species will receive some attention

Reprint Available

Reprints of the "Identification of Montana's Most Common Game and Sport Fishes," which appeared in the May/June 1981 issue of *Montana Outdoors*, are available for 50 cents per copy. This full-color, eight-page guide, with text by George D. Holton and paintings by Glenn West, includes scientific and common names, distinguishing characteristics, habitat details and a distribution map for each fish. Send your order with payment to *Montana Outdoors*, Department of Fish, Wildlife and Parks, Helena, MT 59620.

from the program. This highlighting of certain species cuts the job down considerably, but it still isn't easy. Only one biologist handles the program for the entire state—that's a 93-million-acre study area.

Considering the size of this task, it is clear that an additional funding source is needed. The department has long subscribed to the "user pay" philosophy. It works well with game species, but for nongame animals, no mechanism exists for interested persons to support the efforts.

Even though Montana has had a nongame program since 1974, it has never become a significant portion of overall department operations. Lack of funding is the main reason, and efforts to fund it with an alternate source have so far failed. As a result, only state license fees and, more recently, some Pittman-Robertson funds have been used to support the program.

Funding problems are not new to state agencies. Frequently, legislation designed to accomplish a task will be passed by the lawmakers, but funding to support the new program will not be approved. This is precisely what happened with Montana's Nongame and Endangered Species Conservation Act. Nonetheless, the department proceeded with the program in an effort to meet the responsibilities mandated by law. An attempt to secure additional funds through sale of "Nongame Decals" has not been very successful.

During the 1979 Legislature, a bill was introduced which would have allowed taxpayers to designate a portion of their state income tax refund for nongame wildlife conservation. This seemed like a nearly ideal approach in that it constituted a voluntary, direct contribution from individual citizens to a specific program. And this approach has been used successfully in several other states. For example, Colorado raised over $600,000 in 1980. In their first year, Minnesota raised $600,000, Kansas $300,000 and Utah $200,000. Unfortunately, the 1979 Montana Legislature rejected this plan.

The basic idea seemed sound, and efforts were again mounted during the 1981 legislative session to secure such a funding mechanism. The bill met stiff resistance in the House and was killed. Having failed twice, there appears to be little point in trying again.

Without a funding source, the future of the nongame program is uncertain. Faced with spiraling operational costs and a limited income, the department is in a poor position to contemplate additional allocation of funds to a nongame program. It will require luck and ingenuity just to maintain the status quo. Even this maintenance depends on future license fee increases, and the time could come when the nongame program is cut even further.

Even so, we intend to keep it around. The department is charged with the responsibility of maintaining secure populations of all wildlife species—a responsibility we don't take lightly.

In addition to being reliable indicators of the land's vigor, diversity and stability, nongame animals have other value. Simply taking the time to see, hear and enjoy some of nature's creatures can be a rewarding experience.

The department will continue to pursue responsible enhancement of nongame wildlife, to the extent of our capabilities. To do less would be a dereliction of our duties.—*Dennis Flath, nongame biologist*

SIDE BY SIDE

That's what a year's issues of *Montana Outdoors* will be if you take advantage of the handsome, leatherlike binder pictured above. In addition to keeping an entire year's magazines in one place, the binder protects them and puts our timely, thought-provoking issues at your fingertips.

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For each personal or gift order, send $5 to: *Montana Outdoors*, Department of Fish, Wildlife and Parks; Helena, MT 59601.

Keep a "Fisherman's Log"

If you fish regularly in Montana and aren't keeping a "Fisherman's Log," the department's Fisheries Division wishes you would start to do so.

Fishermen are asked to record the name of water fished; hours fished on each water; the date; the county or nearest town, and the kind, number and average length of fish caught. Every scrap of information collected is utilized in some way, according to George Holton, assistant administrator of the Fisheries Division.

Holton pointed out the log has been a valuable tool in determining the effectiveness of fish management programs and trends in individual waters. Because the program has been operating since 1951, present trends on a specific stream can be compared with older records.

The log is available free from the Fisheries Division, Department of Fish, Wildlife and Parks, 1420 E. Sixth; Helena, MT 59620. Your log will be recalled in November or December, the information recorded and the log returned to you.

Contributors

• Lightning is beautiful. But as **Don Fuquay** writes, "...many people don't understand lightning and fail to take the proper safety precautions during thunderstorms." His article explains what you should do when lightning comes, how lightning is generated and conducted, how it strikes and how it can cause death and injury. He also exposes some myths about lightning—including the misconception that it never strikes twice in the same place. Fuquay is the chief research meteorologist for the Northern Forest Fire Laboratory in Missoula. He has been involved in fire research for the Forest Service since 1958 and is currently working on forest fuel ignition by lightning. Turn to "Flash & Fury in the Sky" on page 2.

• Early research by department fisheries biologists revealed that sauger spawn mainly in the Tongue and Powder rivers, the two lowermost major tributaries to the Yellowstone. But adequate stream flows have not been granted for the Tongue during the spawning season, and pending litigation may affect the instream flow on the Powder. To understand the importance of the Tongue and Powder as spawning areas, turn to **Russell F. Penkal's** article, "Search for Sauger," on page 11. Penkal is a department fisheries biologist who has worked on the Lower Yellowstone Project since 1977.

• The Arctic grayling has been called a "new kind of white and silvery trout," "the pride of the angling fraternity of the Treasure State" and "the flower of fishes." However described, this elegant relic of the Ice Age is in a battle for survival in Montana streams. **Norm Peterson** suggests that Montana's stream-dwelling grayling is "Worthy of 'Extra Special Concern.' " Turn to his article on page 14. Peterson is the habitat preservation coordinator in the department's Fisheries Division. He also serves as a member of the *Montana Outdoors* Publications Advisory Board.

• Studying the environment, shooting a shotgun, learning how to wrap a fishing rod, canoeing and many other outdoor activities are part of the curriculum in many schools today. **Spencer Sartorius** notes that much has been written abut the "back-to-the-basics" push. But what could be more "basic" than understanding the interrelationships between all living things? For the past four years, the Department of Fish, Wildlife and Parks and the Office of the Superintendent of Public Instruction (OSPI) have jointly offered teacher training workshops in outdoor education—more than 200 teachers have participated. There's no doubt about it—"Outdoor Education—It's Here." Sartorius is the health and physical education specialist for the OSPI. Turn to his article on page 18.

• **Charles Wood** writes: "You define a stream by how you use it. It's a boy's playground. A battlefield. A farmer's life line. A fisherman's weekend mistress. A city's water supply or its sewerage. An industrial tool. A miner's sluice box. Each consumer of a creek—this one is called the Prickly Pear—sees it differently. And definitions clash." The clashing definitions have set the stage for the "Battleground at Prickly Pear." There is, however, hope that the battle could be won, mostly because of the Prickly Pear Task Force. Turn to Wood's article on page 20. He is the information officer for the Department of Health and Environmental Sciences Water Quality Bureau. He expands his love of and concern for small streams by another of his interests: tying his own flies and trying them out.

• Recreational horse ownership is growing in Montana and throughout the nation. If the trend continues, by the year 2000, there will be more horses in the United States than at any time in history. For a look at the reasons for this boom in horse ownership, and some of the resulting problems, turn to "Preserving a Place for the Pleasure Horse" by **David G. Conklin** and **G. Wesley Burnett.** Conklin is the department's parks manager for the Miles City Region. Burnett is an assistant professor in the Department of Recreation and Park Administration at Clemson University in South Carolina. He was formerly chief of the Planning and Project Administration Bureau for the department's Parks Division in Helena. Their article begins on page 28.

• As each one of us seeks out his or her chosen experience on a river, it becomes more and more difficult to be alone. As **Ron Marcoux** writes, "Solitude and quiet may be interrupted by laughter, and the scenery around the next bend may include other floaters. The more secrets of the river that unfold, the more people who go to the river to discover them." Montana's Madison is such a river, and the core of the problem seems to be the increasing number of boat users on the upper Madison and their conflicts with other users, such as bank fishermen. As the number of users continues to grow, more clashes can be expected between the various interest groups. Marcoux is the department's fisheries manager for the Bozeman region. Turn to "Social Conflict on the Madison" on page 31.

• From 1935 to 1941, Civilian Conservation Corps recruits had a chance to view "Wonder Underground"—Montana's Lewis and Clark Caverns. And because of their work, the public was able to view one of Montana's most spectacular and unique resources. Today's visitors may not notice the many alterations which make a tour through the caverns possible—the hand-chiseled steps, enlarged passageways, railings and many other improvements resulting from the CCC efforts. For a look at this period of the caverns' history, turn to **Ken Karsmizki's** article on page 33. Karsmizki is a graduate student in history at Montana State University in Bozeman, specializing in Montana history and cultural resources. He worked as a guide at Lewis and Clark Caverns State Park and has been involved in research about the caverns' history since 1978; he welcomes further comments from readers that might assist him in his research.

• MO is pleased to welcome the work of **Shirley Cleary** of Helena. Her back cover for this issue is done in gouache, an opaque watercolor technique. She has participated in many competitive and invitational exhibitions all over the United States. Her artwork appeared in the April 1981 issue of *American Artist* and will appear in a fall issue of *Art West*. She says of her paintings: "My work deals with subjects that are important to me and my life. When I moved to Montana 10 years ago, it was to be with the outdoors and to fish."

• We're also pleased to display the work of another first-time contributor, **Mitchell Paulson** of Helena. His pencil sketches accompany "Search for Sauger" and "Preserving a Place for the Pleasure Horse." With experience in scientific illustration as well as commercial art, Paulson is part owner of a commercial graphics firm in Helena.

• Special thanks to the following photographers and artists whose work appears in this issue: **Tim Lucas,** Dillon; **Tony C. Caprio,** Missoula; **Mike Logan,** Helena; **Louis M. Kis,** Kalispell; **Jerry Manley,** Butte; **Glenn West,** Bozeman, and **Robert Neaves,** Missoula.

Tagging studies show that sauger (above) migrate out of the Yellowstone River in April, spawn in the tributaries and return to the Yellowstone by mid-May. Other tagging studies indicate that almost all walleye (below) caught in the Yellowstone during early spring return later that spring to Garrison Reservoir in North Dakota (DFWP photos: Russell Penkal).

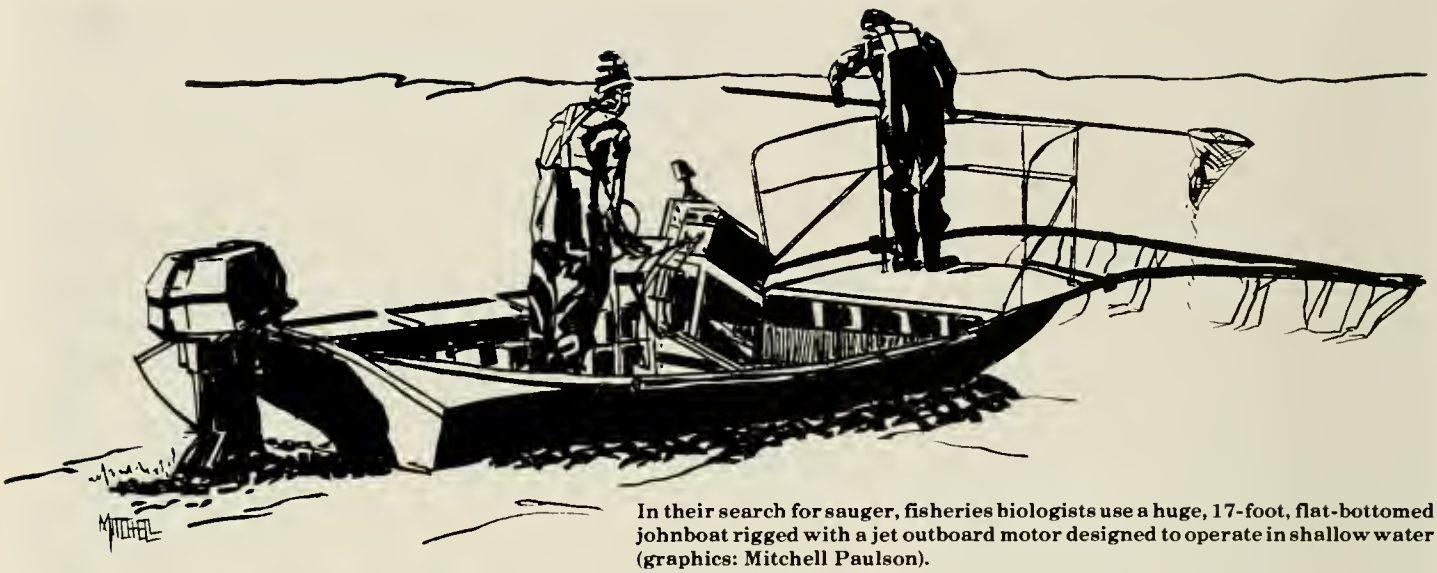
Search for Sauger

by Russell F. Penkal

Vibrant shoots of willow fuse into a greenish blur as we slowly drift by. The cottonwoods looming over them are still naked and stark. Only in the last few days have new shoots of grass started to push their way through the lifeless litter of the previous year's growth. Geese angrily honk their protests as we pass a gravel bar. Paul Ekness, a field technician, and I, a fisheries biologist, both working for the Department of Fish, Wildlife and Parks, have spent five days on the lower Yellowstone River and traveled 100 miles downstream from our departure point searching for sauger spawning areas on the main river. We began our float near the mouth of the Tongue River on April 19, 1980, one day after the first mature female sauger was captured and at a time when sauger were concentrated in the Tongue and Powder rivers.

Paul, standing near the bow of the boat and armed with a long-handled net, dips a small sauger out of the river and places it into the fish-holding tub. Our craft is not the typical canoe or rubber raft usually observed on the lower Yellowstone, but rather a huge, 17-foot, flat-bottomed johnboat rigged with a jet outboard motor designed to operate in shallow water. The boat is also equipped for electrofishing and contains a 220-volt alternating current generator and a rectifier unit which converts the electricity to pulsed direct current. From booms extending out of the bow, metal electrodes direct electricity into the water while steel "tentacles" hang off each side and complete the circuit. When the boat passes over fish, the electrical current causes them to swim toward the positive electrodes (off the bow) where Paul can net them.

In a quiet reach of river, I stretch on



In their search for sauger, fisheries biologists use a huge, 17-foot, flat-bottomed johnboat rigged with a jet outboard motor designed to operate in shallow water (graphics: Mitchell Paulson).

my toes in an effort to peer over the high bank to check a tree-studded island for signs of wild asparagus. Seeing none, my thoughts begin to drift over the reasons for our downstream float.

In 1973, the DFWP began research on the lower Yellowstone River and its tributaries to determine how much water should remain within the river channels (instream flow) to maintain a viable fish and wildlife resource. The need for this research was twofold: (1) An energy-hungry America was casting its eyes toward the coal deposits of southeastern Montana and the area was threatened with numerous energy conversion plants with a prodigious thirst for water. The major source of water in this semiarid region is the Yellowstone River and its tributaries. (2) With the possibility of overallocating Yellowstone River water to various users, the 1973 Montana Legislature established the Montana Water Use Act which recognized the immeasurable value of fish and wildlife. This act allowed the DFWP to file for instream flows.

In 1978, the research proved its worth when the Montana Board of Natural Resources and Conservation granted an instream flow reservation on the Yellowstone to the DFWP and the Department of Health and Environmental Sciences concurrently. Approximately 5.5 million acre-feet (MAF) was reserved near the Yellowstone's mouth at Sidney. Historically, the average annual discharge of the Yellowstone River was between 11 MAF and 12 MAF while present use has reduced that to 8.8 MAF.

The sauger *(Stizostedion canadense)* was initially chosen for study because (1) it is the most abundant predator in the lower Yellowstone, (2) sampling gear was developed which could effectively measure the sauger population in this large river and (3) certain exacting environmental requirements of this cool-water predator suited it to instream flow studies.

Sauger inhabit the lower 350 miles of the Yellowstone River, from Billings to the North Dakota border. They are most abundant, however, from Forsyth downstream to the mouth (the lower 237 miles). The sauger is native both to the Yellowstone and Missouri rivers of Montana.

Sauger belong to the perch family and are close relatives of the walleye. Sauger are readily caught by hook and line, particularly in early spring and fall and their flesh if flaky, firm and delicious. Average size in the Yellowstone is about one pound, but sauger over seven pounds have been collected by biologists and are occasionally caught (the state record sauger weighed seven pounds, two ounces).

Early research revealed that the Tongue and Powder rivers, the two lowermost major tributaries to the Yellowstone, are main spawning areas for sauger. Tagging studies showed that sauger migrate out of the Yellowstone River in April, spawn in the tributaries and return to the Yellowstone by mid-May. Homing tendency to the same tributary from one year to the next is high, with over a 50% return rate in the Tongue.

But adequate instream flows have not been granted for the Tongue River during the spawning season. The DFWP was granted 75 cubic feet per second as a constant discharge, 365 days a year. This represents less than 12% of the average flow during April and early May when sauger spawn. The minimum discharge necessary to stimulate large-scale sauger migration into the Tongue River is more than 300 cubic feet per second—four times the allocated flow.

A great volume of water has been allocated for instream flows in the Powder River, but pending litigation may affect the reservation.

How important are these spawning areas in the Tongue and Powder to overall reproduction in the entire lower Yellowstone River? A hint to the answer came in spring 1979 when the Yellowstone River from Forsyth to the mouth of the Tongue River was sampled with electrofishing gear. Only one sexually mature sauger was collected in this 52-mile reach; during the same time, literally hundreds of sauger were collected in the Tongue and Powder rivers. Could this suggest that loss of spawning grounds in the Tongue and Powder would result in the demise of the sauger population in the entire Yellowstone River?

Paul is dipping young sauger out of the river and dropping them into the live tub. We are 15 miles downstream from Glendive where the river broadens into

many side channels and forms many large islands. We had collected shovelnose sturgeon and watched the wakes as many more darted away from our electrofishing gear. I had wondered when we would find our first large concentration of mature sauger. Even the rapids below the mouth of the Powder River—which I was almost sure would be a good spawning area—produced only an occasional mature male or female sauger.

A brilliant green and gold flash catches my eye as a walleye slips to the electrode without breaking the surface. Effortlessly, Paul guides the dip net under the three-pounder, lifts it over the guard rail and plunks it into the holding tub.

Walleye, which are not native to Montana, generally inhabit lakes, reservoirs and slow areas of large rivers. They often migrate out of lakes and into rivers for approximately two weeks during early spring to spawn. In 1976, department fisheries personnel located a major walleye spawning ground downstream from the Intake irrigation diversion. Subsequent tag returns from anglers and electrofishing revealed that almost all walleye caught in the Yellowstone during early spring return later that spring to Garrison Reservoir in North Dakota. They swim an average of 140 miles each way on their migration to and from the Yellowstone River.

Most sauger, in contrast, reside in the Yellowstone River or its tributaries year-round. Sauger are capable of crossing with walleye, and a hybrid results. If this occurs extensively, the primarily river-inhabiting sauger could slowly be incorporated into the walleye population of Garrison Reservoir. In Lake St. Clair and Lake Erie, where sauger are now rare or extinct, researchers have suggested that sauger were incorporated into the walleye population by hybridization after a period of low sauger numbers.

As I turn the boat upstream and motor along shore, Paul jumps out. "Immature sauger, 280 millimeters, 120 grams, number 11,505," Paul barks out as he determines the sexual condition of the fish, its length, its weight and marks it with a numbered tag. I write down the information and collect a few scales from the fish to determine its age.

"That sure seemed like a long section," Paul exclaims as he slips the last fish into the river and begins stowing the tagging equipment.

"It sure did," I say, unaware we had been adrift for three hours in a side channel that should have taken no more than an hour and a half to electrofish.

"Do you think we'll make Intake tonight?" Paul inquires.

"Probably so," I reply, "but not much before dark, especially if we don't get going."

"Well, I hope Lani and Terry are there," Paul exclaims over the din of the generator.

Lani Morris and Terry Hightower are DFWP fishery field workers. On contract through the Bureau of Land Management, they are investigating the many small streams and creeks which flow into the lower Yellowstone River to determine the present distribution of fish in these streams. Many of the drainages encompass rich coal deposits.

"Good evening, gents," Terry exclaims as Paul and I march into their camp. "How goes your journey?"

"Okay," we say, "except we only captured 85 mature sauger and we've floated 115 miles!"

"Looks like those tributaries are even more important for spawning than anyone could have imagined," Terry concludes.

"Yup," I say, "it sure does. It's easy to give those two muddy streams a low rating by just looking at them.

"Well, we'd better get the boat unloaded before it gets too dark," I suggest.

As Paul and I walk upriver, a fisherman stops us immediately below the Intake irrigation dam. "I snagged a weird-looking critter and wonder if you guys know what it is," he says.

As I reach into his dark minnow bucket, the fisherman yells, "Careful! That varmint is loaded with teeth!"

My instinct for self-preservation is greater than my curiosity and I quickly jerk my hand out of the minnow bucket. Then, with extreme caution, I slide my hand back into the bucket and emerge with a 10-inch, silvery fish with lots of teeth.

"Well?" the fisherman prods.

"A rainbow smelt," I conclude. "I heard that North Dakota planted a bunch of these in Garrison Reservoir, but this is the first I've seen."

"Why did North Dakota plant them and what are they doing in the river?" he inquires.

"I think they were planted as a source of walleye food," I answer. "Smelt run upstream about the same time of year as walleye to spawn."

"With teeth like that, what are those smelt going to do to the little fish in the river?" asks the fisherman.

"That's a good question," I answer. "Large numbers of smelt could be in the Yellowstone River when many larval (just hatched) sauger and walleye are floating downstream. Smelt are carnivorous and could severely impact the young fish population. This is particularly important in the Yellowstone because the most important rearing area for young sauger and walleye, as well as for a host of other species, is downstream from Intake—the area where smelt concentrations will probably be greatest. Various researchers have listed the smelt as contributing to the decline of the walleye fishery in the Great Lakes."

"Well, I'm going to take this critter and show the guys in town what I caught," the fisherman declares. He loads the minnow bucket into his truck and drives off.

By the time we secure the boat and transport our equipment downstream from the diversion, it is well after dark.

The next morning is warm for April and I gaze at the cloudless sky in appreciation. Paul shoves the boat off and we motor to within 30 yards of the sloping Intake diversion structure. I crank on the generator and turn the boat downstream to prepare for electrofishing.

"There's three more fish on your left Paul!" I yell over the drone of the motor.

"I can't get them. There's just too many," Paul hollers back, plopping eight large walleye into the tub. In the meantime, I, too, dip several walleye that float by us as I guide the boat downstream.

"I can't believe it," Paul yells. "I've never seen so many fish in one place in all my life." He tries fruitlessly to net all the walleye that swim toward the electrodes.

"We captured 160 walleye in that mile and a half reach, Paul," I note as we finish tagging the fish.

"I probably missed that many more," Paul replies.

"In 1978, I estimated the population of spawning walleye in this reach at 2,600 fish or 4,000 pounds—over one ton of walleye per mile! However, there seems to be even more this year!" continued on page 25

Montana's Stream-Dwelling Grayling

Worthy of "Extra Special Concern"

by Norm Peterson

THE EARLIEST description of the Arctic grayling in Montana came from explorers Meriwether Lewis and William Clark in 1805. They caught this "new kind of white and silvery trout" in the Beaverhead River near what is now Clark Canyon Reservoir. Grayling *(Thymallus arcticus)*, are now classified as belonging to the salmon/trout family, Salmonidae. Therefore, Lewis' and Clark's observation was most astute.

Preferred grayling habitat is similar to that preferred by many trout species—clear, cold water (50-60°F) in streams and lakes. The grayling's diet consists primarily of aquatic and terrestrial insects, some algae and occasionally fish. They spawn in spring and females may have more than 12,000 eggs. Unlike trout, however, they build no redds (nests dug out in streambed gravels), but broadcast their eggs. Eggs develop in a relatively short time, 11-22 days. Immediately after hatching, young grayling migrate, the direction depending on the strain or race to which they belong. The oldest grayling studied by biologists was about 10 years old, but few live past 6. A grayling weighing over two pounds or measuring longer than 17 inches is rare. (The state record grayling weighed two pounds, 10 ounces, and measured 18 inches long.) Even though they are often mistaken for mountain whitefish, grayling have a distinguishing characteristic—an extremely large and colorful dorsal (top) fin. The brilliant colors in this fin range from iridescent shades of blue and green to pink. In his 1971 book, "Fishes of Montana," Dr. C.J.D. Brown wrote: "There is no other game fish more unique to Montana. It deserves to be designated as the state fish." But in a 1976 statewide contest, the "black-spotted" cutthroat trout won and was named state fish by the Legislature.

Original worldwide distribution of grayling includes four distinct species—one in Europe, two in Asia and one in North America. The latter historically ranged from Siberia to Alaska through much of Canada and into Michigan and Montana (see map). The Michigan population became extinct in 1936.[1, 2]

The Montana population originally inhabited the headwaters of the Missouri River above Great Falls. Most were found in the Gallatin, Jefferson, Madison and Smith rivers and their tributaries, as well as in the Sun River. In 1889 (article published in 1891), D.S. Jordan[3] wrote that they were very abundant in the

Madison River below the junction of the Firehole and Gibbon rivers. These original (endemic) populations were reported to dwell almost exclusively in streams, and were only secondarily residents of lakes.[4] These original strains were later used as transplant stock for lakes across Montana.

Much has been written about the Arctic, Michigan and Montana strains being different subspecies or even different species. The following theory is most frequently used to explain the distinctions between the three populations: During the last Wisconsin glaciation (12,000 to 15,000 years ago), which covered large sections of the North American continent, the three populations became geographically isolated and time and habitat differences prompted slight genetic variations.

Grayling distribution in Montana has changed dramatically since man began to record his history, and it is often a map of confusion. Bob

A sparse population of reproducing grayling still remains in beautiful Park Lake (left), near Helena (photo: Mike Logan). The colorful rendition of the grayling is by artist Glenn West.

Cooney, a retired Department of Fish, Wildlife and Parks employee, recalls that his father told stories of abundant grayling in the Missouri River in the area of Canyon Ferry in the late 1870s and 1880s.

In 1971, Dr. R.L. Graham, former leader of the Cooperative Fisheries Unit at Montana State University in Bozeman, reported catching grayling "...as if they had been perch" below Meadow Lake in the Madison River when he "...was a youngster 30 years ago."

Dick Johnson, supervisor for the department's Glasgow region, reported grayling in the Sun River as recently as 1970; Ron Marcoux, the department's fisheries manager for the Bozeman region, reported grayling in 1975 in the South Fork of the Madison. Today, both streams are believed barren of grayling.

An old-timer who delivered mail throughout the Centennial Valley of southwestern Montana reported resident populations "...all through basin streams years ago." A study of the Centennial Valley which I conducted in 1976 (published in 1979)[5] indicated only three valley streams were being used. They were inhabited only during spawning runs from Upper Red Rock Lake where the grayling lived the rest of the year.

In 1962, E. Richard Vincent, a department fisheries biologist in Bozeman, wrote that grayling were present in 21 lakes and 29 streams.[6] In the Sept./Oct. 1971 issue of *Montana Outdoors*, George Holton, assistant administrator of the Fisheries Division, reported that self-sustaining populations were present in 39 lakes and 14 streams in western Montana on both sides of the Continental Divide. In the Jan./Feb. 1980 issue, he wrote that remnant populations were found in 30 streams in the Missouri drainage "...and in perhaps 10 other Montana streams."

A U.S. Fish and Wildlife Service report in 1973 stated 20 lakes and 25 streams in Montana harbor relic and transplanted populations.[7] In 1975, John Varley, a fisheries biologist in Yellowstone National Park, wrote in a personal communication that he estimated that grayling had been reduced to only 4% of their original river range in Montana.

This leads to the question: What is the present status of grayling in streams and lakes in Montana?

What has often been described as the last stronghold for river-dwelling grayling in the lower 48 states—the Big Hole River drainage—may be their *only* stronghold. Even here, their hold is tenuous at best. Only 15 streams, including the upper Big Hole River itself, are known to contain grayling. Of these 15 populations, five are found in streams that run into or out of lakes; these fish may live portions of their lives in the lakes and then migrate to rivers to spawn and remain as residents for a portion of the year.

Seven streams in the Flathead River drainage have grayling; however, biologists believe that grayling migrate to all seven streams from lakes within the drainage. The same can be said for resident grayling in the Madison River above Ennis Lake, the two forks of Hyalite Creek above Hyalite Lake, Broadwater River downstream from Rough Lake and the Belly River below Elizabeth Lake in Glacier National Park.

Therefore, the most recent information indicates that only 10 streams in Montana have viable, self-sustaining grayling populations—and all are Big Hole valley streams. An additional 17 streams are known to have grayling, but they appear to be migrants from upstream lakes.

A unique, self-sustaining grayling population is found in the Sun River slope canal which runs out of Pishkun Reservoir. The reservoir was stocked with grayling years ago. Apparently, some of the reservoir stock migrated downstream and were able to propagate and survive year-round.

continued

The picture for lake populations appears somewhat brighter: 33 lakes and reservoirs contain grayling. Although most are listed as having sparse populations, a handful are in fact overpopulated.

Before we condemn earlier estimates of streams and lakes in Montana containing grayling, we should realize that the information we had at that time was, at best, "none too good." Recent emphasis by the DFWP on gathering and storing information about grayling and studies such as that conducted during 1979-80 on the Big Hole River drainage by George Liknes, who was doing graduate work at MSU, shed a great deal of light on the situation.[8] On the optimistic side, Liknes believes several small Big Hole River tributaries not part of his study may contain viable grayling populations. Obviously, more study is needed before a complete picture can be presented.

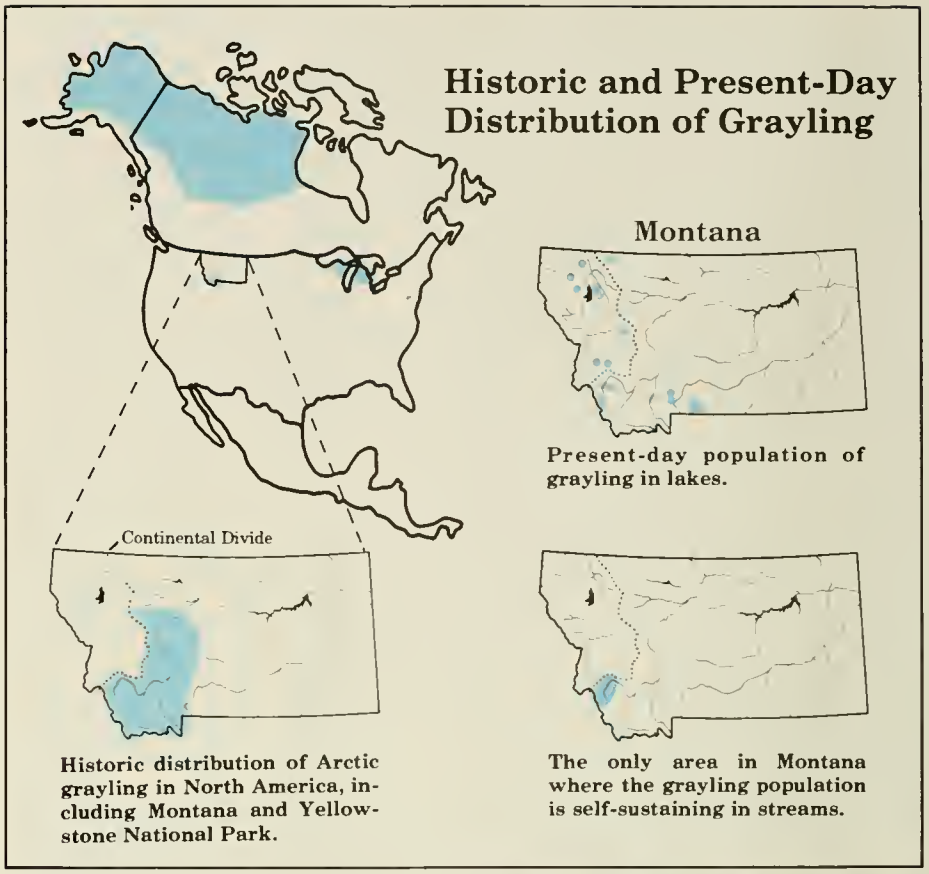
What must the department do to stabilize or increase the number of streams containing self-sustaining grayling populations? I believe—as do other fisheries biologists—that the all-important first step is to assume there is a genetic difference, no matter how small, between the lake-(lacustrine) and stream-(fluvial) dwelling forms.

In 1979, the Endangered Species Committee of the American Fisheries Society designated the Montana stream-dwelling strain as a fish of "special concern," thus assuming a difference does exist. Both Varley (in a personal communication) and Dr. E.R. Vyse, associate professor of genetics at MSU (in a letter to the department), suggest a genetic difference. Dr. Vyse further wrote: "If there are distinct genetically controlled differences between the two forms, it is suggested that the lacustrine form, historically rare in the Montana range of species, is now widespread while the historically common adfluvial form is threatened with extinction."

If we accept this difference between the lake and stream forms, what brought about the rapid decline in the stream population? Vincent, in his 1962 dissertation, wrote: "Grayling have a narrow ecological amplitude that limits their distribution to certain streams or certain sections of streams" and that "there are indications that competition from recent invading fishes and man-caused habitat changes become limiting before water temperatures." He listed four major causes for the decline—(1) climatic, (2) exploitation, (3) introduction of exotic fish and (4) habitat change.[9] Of the four, only climatic changes would occur if man were not present. Vincent summarized by indicating that man and the recent changes he has made in grayling habitat, coupled with the grayling's inability to quickly adapt to these changes, were directly responsible for the decline.

In 1979, J. C. Lynch and Dr. Vyse published a report with information supporting Vincent's 1962 thesis that grayling are not as genetically adaptable as exotic fish (e.g., brook, brown and rainbow trout). They indicated that rainbow are "ecologically plastic, occupying a wide range of habitats" whereas grayling lack extensive genetic variability.[10]

J. D. Dean and J. D. Varley, writing in 1974 about Yellowstone National Park waters, noted: "...among the native species, the Arctic grayling has suffered most from man's activities."[11] The "activities" they were referring to included increased fishing pressure (grayling are easier to catch than most other game fish)


Historic and Present-Day Distribution of Grayling
Montana
Continental Divide
Present-day population of grayling in lakes.
Historic distribution of Arctic grayling in North America, including Montana and Yellowstone National Park.
The only area in Montana where the grayling population is self-sustaining in streams.

Many grayling populations associated with streams merely move into streams for spawning and return to lakes for the remainder of the year (photo: Louis M. Kis).

and competition from exotics such as brook, brown and rainbow. They were obviously not referring to habitat change because their studies have been conducted within the park where habitat change due to man is minimal.

This combination of more fishing pressure coupled with the ease with which grayling can be caught gives a tremendous edge—right at the outset—to the exotics. Add the reduced ability of grayling to adapt and one quickly recognizes that even where habitat changes are minimal, success of a grayling stocking or restocking program would be doubtful—unless competitor exotics were eliminated and grayling harvest were restricted.

A restocking program was attempted in Yellowstone National Park in the 1970s. In a personal letter, Varley wrote that the initial attempt in 1971 at restocking small headwater streams of the Missouri River in the park was unsuccessful. The grayling transplanted in this early attempt were taken from lake populations. They failed to hold stream position and drifted downstream. A second attempt in 1978 proved about as fruitless. However, during the second attempt, grayling were transplanted from stock taken from the upper Big Hole River and two of its tributaries. Thus, it appears that grayling transplanting options are in themselves limited.

The answer to the question about what originally led to the decline of stream-dwelling grayling in Montana lies to a large extent in their lack of genetic adaptability and the rapidly changing environment in which they live. Lake populations, perhaps because of living in an environment less subject to rapid change, have become fairly stable.

As William Shakespeare wrote in "Julius Caesar": "The fault...is not in our stars, but in ourselves...." This seems an apt reason for greatly reduced or extinct stream populations in many Montana streams. And, the scenario for improvement is not optimistic.

If we are to continue to have grayling in our streams, the department's management options must include some, if not all, of the following:

(1) Recognition of a probable genetic difference between lake- and stream-dwelling populations.

(2) Improvement of historic habitat that has been altered by man. This option may be unrealistic in light of existing laws and water uses.

(3) Designation of streams with adequate grayling habitat and already restricted conflicting uses (e.g., wilderness areas or other federal land) as special grayling management areas, thus emphasizing management of stream-dwelling grayling populations.

(4) Transplanting of stream-dwelling stocks to acceptable habitat in isolated streams or portions of streams (e.g., upstream from a non-passable waterfall in headwater reaches). Competitors must first be eradicated if such a program is to be successful.

(5) Maintenance of restrictive regulations for grayling in streams.

These first five management options relate to more optimum conditions; the next two may be termed the "last chance" scenario and should be used only when all other options have proved ineffective.

(6) Attempting genetic mixing with stocks from Alaska or northern Canada, and possibly introducing a new genetic variability. Of course, this option would alter the original Montana blood line.

(7) As always, the last option is to do nothing—an option that would probably mark the final demise of stream-dwelling grayling in Montana.

Early concern for the potential of this demise was voiced by J. L. Kelly in 1931,[12] Dr. Brown in 1938[13] and P. H. Nelson in 1956.[14] That early concern was met with successful management programs that established self-sustaining populations in many Montana lakes. We need similar programs for grayling in our streams.

James A. Henshall described the Montana grayling as "trim and graceful," Kelly as "the pride of the angling fraternity of the Treasure State," and St. Ambrose, Bishop of Milan, as "the flower of fishes." However described, this most elegant relic of the Ice Age is in a battle for survival in Montana streams—a battle it apparently cannot win without man's help. A first step might be to declare the "true" historical grayling of Montana—the stream-dwelling form—as a fish of "Extra Special Concern."

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Outdoor Education—

VISITING a Montana school today may be a vastly different experience than it was only a few years ago. You may see classes outside studying the environment, shooting shotguns, canoeing, doing water studies, or participating in many other outdoor activities.

Part of the transition from the traditional confines of the schoolroom to the "outdoor classroom" has been the result of a cooperative effort by the Montana Department of Fish, Wildlife and Parks and the Office of the Superintendent of Public Instruction. Much has been written about the "back-to-the-basics" push of today. Few would argue that basic communication skills are needed, but what could possibly be more "basic" than an understanding of the interrelationships between all living things and the links between man and his environment? Outdoor education is *not* a separate discipline. It can be part of every subject area and often can make that subject more meaningful, fun and exciting to the student.

For the past four years, both agencies have jointly offered teacher training workshops in outdoor education for Montana teachers. More than 200 elementary and secondary teachers from all parts of the state have attended one or more of these sessions, and the cooperative effort has resulted in the implementation of outdoor programs in several schools. In summer 1980, 100 teachers attended one of two workshops conducted in the Pioneer Mountains north of Dillon. Each session ran for seven days, with college credit offered through Western Montana College. The purpose was twofold: (1) to give teachers an outdoor education experience and (2) to have them pass on that experience to their students.

Also lending both financial and instructional assistance have been national organizations like the National Rifle Association, Safari Club International Conservation Fund, U.S. Forest Service, Bureau of Land Management and National Park Service. The initial impetus provided by these organizations has led to development of a local cadre of instructors—people who believe in the value of outdoor education and who are willing to donate both time and effort to teacher training.

The program content has been varied—from environmental education to the shooting sports and hunter education, from orienteering to hot air ballooning, from edible plants to geology, from canoeing to plant taxonomy. The varied program allows teachers to select areas of study most appropriate to their particular school, program and setting. Teachers have found there is something for everyone in outdoor education, and that outdoor education can be worked into every curriculum area.

Not only does outdoor education fit into traditional curriculum areas, but it provides more on a personal level. It gives students and teachers alike time to reflect on their lives. It lets them set directions for themselves and provides truly special emotional and spiritual experiences. It gives an inner peace, hard to find in our hurry-up world.

For too many years, we have not put our greatest natural resources to use: Montana—one of the most beautiful, majestic states in the country—offers unending recreational opportunity. Now, with renewed pressure for lumber, coal, oil and water development, we must give our youth the knowledge and skills to make wise decisions about the state's future course. What is the ultimate goal of outdoor education? The wise use of our great state so that succeeding generations may know and experience the beautiful, unspoiled land we call Montana.■

It's Here by Spencer Sartorius

Teacher training workshops provide information about a variety of activities related to the outdoors, such as hot air ballooning, canoeing (photos: Bruce MacIntyre), shooting, rod wrapping and hiking (photos: Spencer Sartorius).

Battleground at Prickly Pear

by Charles Wood

O lost, and by the wind grieved, ghost, come back again.

—Thomas Wolfe

THE GENERAL'S mouth gaped, his ears were pounding. Blood was filling his head as he lay on his stomach, feet up, between the legs of the willows, as if he had sneaked to the front of a crowd to watch a parade. He spotted his quarry across the creek. "North Koreans—millions of 'em!"

Like a retiring turtle, he pulled himself back into the bushes and onto his knees. He knew what he must do. His army was small—sorely outnumbered by the Red battalion camped on the opposite shore—but he was its commander, and only he and the river lay between the invaders and home. And it was his ground, his river, and he knew how to use it, even at his tender age.

His black sneakers kicked up poofs of dust as he darted from bush to bush, closing in on the creek. Then he was out in the open, crossing the gravel bar, knowing that if he couldn't find his river crossing in a couple of seconds he might be gunned down—although he was sure the Commie troops would be careless with their sentries. He knew they knew there was no way across this boisterous brook.

Plik! Plak! Plok! The sneakers sang out as the General's feet caught his secret rocks, hidden just under the water, dead-on center. His wooden saber drawn, he caught the enemy napping. Switch! Swatch! The sword went to work. The invasion was thwarted. The General's village was safe.

Little time, however, was left for the sweet savoring of victory, for sundown was soon and the soft cry of "Dinnertime!" pulled the General back across HIS rocks, across HIS banks, across HIS field and home. Tomorrow there would be battles on the creek bank with the other enemies that lived in the mind of the General in 1952.

You define a stream by how you use it.

It's a boy's playground. A battlefield. A farmer's life line. A fisherman's weekend mistress. A city's water supply or its sewerage. An industrial tool. A miner's sluice box.

Each consumer of a creek—this one is called the Prickly Pear—sees it differently. And definitions clash.

January 1980

"Our ditches are getting mighty full of silt," the irrigator said from the back of the room. "It must have somethin' to do with the way it backs up behind Asarco's dam."

"It's really not our fault," the Asarco engineer replied, as the whole roomful of the Prickly Pear Water Users' Association bent forward to hear the beginnings of a hot debate. "That silt is coming down from upriver," continued the smelterman. "We're not causing it. We have to open our floodgates every year just to flush the stuff out of our old cooling pond."

"And that's violating the state's water quality law," chimed in the man from the state Department of Health and Environmental Sciences. "Your last flush-out smothered aquatic life in the creek below the dam."

What was needed, of course, was a way to stop the silt at its origin above the Asarco smelter in East Helena, and above the irrigation ditches. The meeting in the Helena Valley that winter's night was the first time three different groups of people—the irrigators, the industry and the state—

Loren Bahls of the Water Quality Bureau (opposite page) approaches a familiar, but unsightly, attempt to solve stream bank erosion in Montana—automobile riprap. He found this traffic jam on the lower Prickly Pear. These two photos (left, and immediately below) show the contrast between (1) a channelized section of stream stripped of vegetation, where rock riprap is required to hold the banks intact, and (2) a natural, meandering, well-vegetated stretch. Acid drainage (below left) from the Alta mine, entering from left, stains Corbin Creek, a tributary of the Prickly Pear entering from right, with "yellow boy," a nickname for the iron hydroxide that precipitates to the stream's bottom (Water Quality Bureau photos).

sharing the same body of water had gotten together and discussed this mutual problem. And it wasn't even part of the agenda.

People weren't talking about the creek, some hardly even thinking about it. The General hadn't thought about it much after he started thinking about girls and basketball games and cars. For 10 years, he had hardly even seen the waters he had taken so much delight in roiling with his armies. There was college and there were summer jobs. There was a stint in the Army during the Vietnam War. (the General was brevetted to private). Then there was that first real job in a faraway state.

But came the '70s and the General came home. He found his family had changed, and so had his friends, and East Helena; but most of all, he thought, his creek had changed. Or had it been his own renaissance? The creek did look different—there was a subdivision in his battlefield—but it must have been the new way he was looking, different from a child's way, that reformed his opinion of the Prickly Pear. He now knew that water was a life-or-death concern for many living things, including himself, and that living things, including himself, were responsible for the life or death of a waterway.

By 1980, the General had learned enough to know that the creek he had always pictured as a giant, alluring, wriggling worm was limp and dying on the hook.

"Why can't the smelter discharge warm water into the creek like they used to?" the irrigator asked.

"For one thing, the state won't

allow us to," the Asarco engineer replied.

"That's because the warm water raises the temperature too high for fish and ruins the natural balance in the creek," chimed in the man from the Health Department.

"Bull," said the irrigator. "We used to catch more fish below East Helena when they discharged, because the warm water kept the creek from freezin' top to bottom. The ICE killed the fish."

Man thinks his exploits are making streams better than the good Lord did.

A couple of summers ago, the General decided to reconnoiter a little more of the creek than he had ever seen as a child. From his boyhood home across the subdivided field, he could see that his willow command post was no longer there. Almost no large plants, in fact, could be seen for a long stretch down the stream bank.

An hour later the General cried, actually cried, when from atop a crumbling dirt bank he saw that the Prickly Pear was bone dry. The General had never seen a river dewatered by irrigation. Sure, he'd heard that such things happened, even for a couple of miles below East Helena, but THIS dry?

"What about the fish?" he said aloud.

"What'll stop the North Koreans now?" asked a 7-year-old inside his head.

Dick Pedersen of the Water Quality Bureau (right) examines an eight-foot vertical bank which will probably fall away during spring runoff and contribute sediment to the lower Prickly Pear. Gary Ingman (below), an environmental specialist for the Water Quality Bureau, examines the dewatered stretch of the Prickly Pear below East Helena during the stream bank inventory conducted in August 1980 (Water Quality Bureau photos).

On a warm autumn day in 1979, the state Water Quality Bureau and the Department of Fish, Wildlife and Parks took 25 people on a tour of practically the whole length of the Prickly Pear. While many were government officials from agencies that deal with streams, the real audience was the potpourri of water users who, willing to show that they share the creek without sole title to it, came out of the closet for a day. There were ranchers, a water plant operator, men from the Asarco smelter and the Kaiser cement plant, sportsmen, environmentalists, a couple of legislators, a construction union man, a city councilman and some loggers. The General was there too.

The Prickly Pear, they were told, is one of the most abused, most altered, most polluted streams in Montana—a petite but proud beauty that's become a trollop. For proof, they were shown:

—A headwaters tributary that runs bright orange from acids draining out of abandoned mine adits and suppresses aquatic life up to 10 miles below its confluence with the Prickly Pear.

—Massive mine tailings piles on which no stream-sheltering vegetation will grow and through and from which the Prickly Pear cuts and carries metal-laden sediments downstream.

—The places where man had straightened the meandering watercourse like cracking a whip, stripping off valuable vegetation and increasing the speed and cutting power of the water. It was done to accommodate a railroad and two highways, including Interstate 15.

—The place where the Kaiser cement plant's settling pond washed out in 1974, killing a significant number of trout.

—A tributary that, during the high spring runoff in 1975, dumped 422 tons of silt from mine tailings, roads and overgrazed land into the Prickly Pear in a single day. That's enough dirt to fill four Burlington Northern coal cars.

—The Asarco dam, which blocks the upstream migration of trout and the downstream migration of sediment. The sediment is a major headache for Asarco and it's at this point that it begins getting into irrigation ditches.

—The dewatered stretch, which is as upsetting to the rancher who uses much of the water as it is to anyone.

—A gravel operation that, somewhere in its long history, has destroyed the natural buffer between it and the creek.

—Huge areas of rock riprap, needed to keep out of the creek good land that has been farmed insensitively and grazed too closely. The vegetation that once held the stream banks intact has been replaced, in some cases, with old car bodies.

—The Helena sewage treatment plant outfall, where an entire city washes its hands of filth too overwhelming for such a small stream to handle. The effluent, especially when the plant isn't operating properly, is disgusting enough to merely see or smell, but the ammonia it contains puts up a barrier to the passage of fish from the Missouri River system below.

"There's not much we can do about all this," concluded the sponsors of the tour. "Only the people who use the creek can clean it up."

Several weeks after the tour, the General found a letter on his desk. Sent by a group called the Prickly Pear Sportsmen, the letter invited the General to join them on a citizens' task force that would try to improve things on the creek. I'd be happy to, the General shot back his reply.

That evening, on his way home, the General stopped at a spot on the creek the tour guides had said was in pretty good condition. He worked his way down between the legs of the willows to the foot of a riffle that provided a good mix of fast water, oxygen, rocks and temperature for thousands of stonefly, mayfly and caddis nymphs that, in turn, provided sustenance to trout that lay in pools below.

The General found magic that evening. Having abandoned boyhood war fantasies long ago, he conjured up a Sioux-like vision, backed by a chorus of willows and alders softly humming in a light wind: Out of the glug-glig-gurgle of the riffle came the voice of a ghost-creek, a creek that had begun to die in 1864 when the white miners came to its valley, a creek that couldn't cope with dredges, farms, factories, cities and highways, a creek that has fought and fought and fought to stay alive and now so desperately wants to be reborn. But the ghost-creek wasn't seeking pity, it was seeking help. Its song was not sad; it was more like an Easter canticle, full of hope. And the General heard, as others have heard.

In January 1981, the Prickly Pear Task Force conducted its first meeting. There were a dozen members, including the General: the presidents of the Prickly Pear Sportsmen and the local Trout Unlimited chapter, Asarco's environmental scientist and an official from Kaiser, an East Helena city councilman, a Jefferson County planner, a supervisor of the Lewis and Clark County Conservation District, two ranchers along the creek who happen to be legislators, a member of the Prickly Pear Water Users' Association and the chief operator of Helena's sewage treatment plant.

By the end of the meeting, a seemingly impossible dream—of putting the Prickly Pear back into a condition that at least SEEMED natural, that would provide good-quality water for its many users, including the fish—had wended its way toward reality.

The Department of State Lands, the task force was told, had sent to the Interior Department a proposal to reclaim hard-rock mine sites that were polluting the tributaries. Under the Abandoned Mine Lands Program, the federal government would use mining tax revenues to pay the horribly expensive tab for keeping toxic waters from reaching the creek. If the package were approved in the spring of 1981—and it was expected to be—preliminary work could begin this summer.

The Lewis and Clark and Jefferson County Conservation districts, on July 1, 1981, were granted funds by the Water Quality Bureau to begin helping landowners change the land use practices that have defiled the creek. The districts will help the landowners determine what needs to be done, and then will help them acquire money to carry out the job. It's strictly a voluntary program.

The Soil Conservation Service wants to begin soil tests soon so that revegetation of tailings piles, if those soils will allow, can begin this summer.

A stream bank inventory and water quality report was completed recently by the Water Quality Bureau with the help of other state and federal agencies. It should help the task force decide where to put its efforts.

A major landowner along the dewatered stretch said he'd trade his water right for an instream flow in the Prickly Pear if the task force can get him enough irrigation water from the Helena Valley Irrigation Canal. The task force is working on it.

The state Water Quality Bureau will continue to work with the Helena sewage plant to improve its effluent. And Asarco is trying to end seeps into the creek from under its huge slag pile. Other property owners and businessmen, experts, highway and railroad people will be called in to join the "movement."

And other ideas, some almost farfetched, will be pondered. Can there be more trade-off among irrigators without compromising water rights? Can we store some water off-stream to prevent a no-flow situation every summer? Why not put a fish ladder on Asarco's dam, or remove the dam completely? Can we use earth-moving equipment to rebuild the natural meanders instead of ripping them out? Are there people in the area who'd volunteer to hand-plant willows and rebuild trout habitat?

Up to this point, it was not as important that these questions be answered as it was that they be asked.

Still, this is not a summer during which the General will want to swim or fish in the Prickly Pear. But he's likely to wander through the legs of the willows, spinning his own visions to the ghost-creek, wondering if a creek can come home again to the way it was in 1863—beautiful, life-sustaining, and beckoning man to use it graciously.

The General, sadly enough, knows his ammunition is running low. Money for water quality improvement is being cut from state and federal budgets.

But this one citizen, in his mid-30s and slightly greying now, still hopes enough generals will enlist to be foot soldiers in the small army fighting for the Prickly Pear.■

people struck by lightning recover with little permanent damage. Most will be dazed and temporarily paralyzed, but soon recover. Aid at an accident scene should be given first to those not moving. Most victims suffering pulmonary arrest can be revived with a few minutes of artificial respiration. Even many of those suffering cardiac arrest can be kept alive by cardiopulmonary resuscitation (CPR) until professional help is available.

Myths and Misconceptions

Misconceptions and myths about lightning abound. Perhaps the most persistent is that lightning never strikes twice in the same place. However, not only can lightning strike the same spot more than once, it can do so during a single storm. Prominent points or structures may be struck many times during a year.

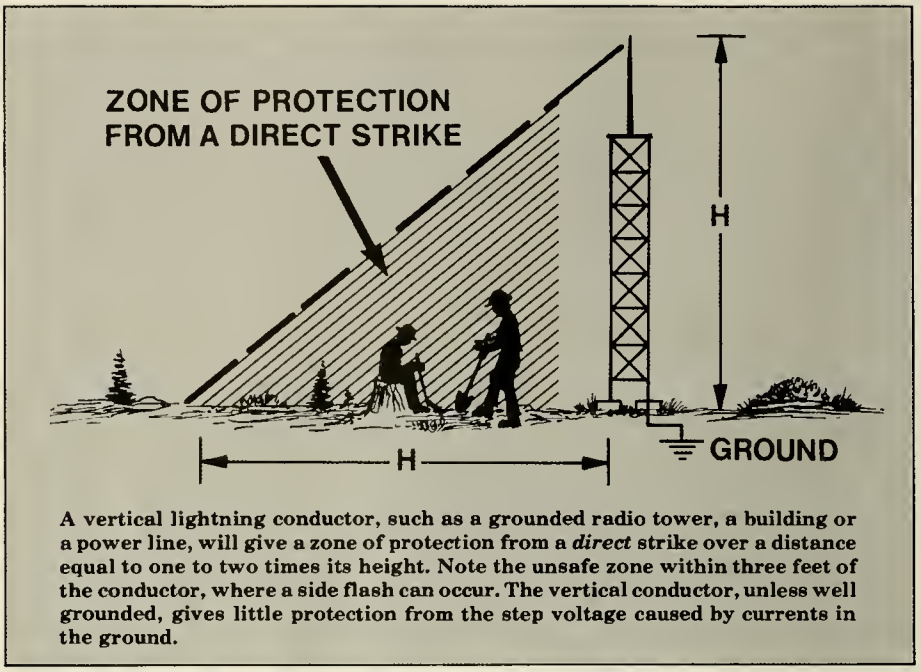
As a thunderstorm moves across the terrain, the lightning moves with it. Nonetheless, the fact that a storm has passed can lead to a false sense of security. There are many instances of lightning striking miles from the boundaries of the cloud, giving rise to the legendary "bolt out of the blue."

Some people believe you can always see a lightning storm coming. This is often true, but not always. Many accident reports stress that the victims were caught by surprise and the lightning appeared suddenly. Quite often a storm will build overhead and the first lightning bolt is the fatal one.

Another very dangerous misconception involves cars, tires and rubber-soled shoes. It is true that a vehicle with a metal top is an excellent shelter from lightning. This is so because the metal of the car conducts the lightning current around the people safely tucked inside. Many believe the rubber tires insulate the car from a lightning strike. Some of these people believe it is safe on the bed of a pickup or the seat of a tractor because of the tires. They are wrong. Lightning, after traveling miles through insulating air, has no trouble flashing across the tires. A car struck by lightning will almost always be found with the occupants unhurt but with the tires blown or aflame.

A recent accident involving a family of seven and a pickup truck will illustrate this point. Lightning struck and critically injured three family members sitting in the pickup bed, while those inside the cab were not even jolted. Again, it is the cloak of metal that gives the protection, and not the tires.

Individuals struck by lightning usually have their shoes or boots torn or blown off their feet. Rubber soles don't help a bit in warding off a direct strike, but might lessen the jolt of a step voltage.



A vertical lightning conductor, such as a grounded radio tower, a building or a power line, will give a zone of protection from a *direct* strike over a distance equal to one to two times its height. Note the unsafe zone within three feet of the conductor, where a side flash can occur. The vertical conductor, unless well grounded, gives little protection from the step voltage caused by currents in the ground.

When Lightning Comes

What should you do when lightning comes? Of course, when you see a storm moving in, you should seek shelter, preferably in a structure with lightning protection. Get away from water or out of an open field. Avoid taking shelter under an isolated tree or unprotected shed. Move near taller conducting objects like towers or radio antennae. Position yourself at least two feet from a tower's legs to avoid a side flash, but stay within the cone of protection. Remain several feet away from metal rods or wire fences; stay away from power lines because they might fall. Remember, a car or a truck cab is an excellent shelter. Stay inside until the storm is long past. If nothing else is available, crouch down in a group of trees or in a thicket. Stay low (but not prone) until the storm danger is past.

Before going out to the fields, onto the water or into the hills, it's a good idea to check area weather forecasts. Most parts of the country are now covered by National Weather Service radio broadcasts on 162.4 and 162.8 megahertz. Inexpensive portable radios which receive these broadcasts are available at radio and appliance stores.

On thunderstorm days, rapidly growing cumulus clouds should warn you of impending lightning. Downward bulges or a column or streak of rain emerging from the cloud base also signal that the cloud has reached a mature state and that lightning is imminent. Sometimes on high mountains or ridges, strong electric fields can cause dry hair to stand on end and produce a tingling feeling in raised fingertips. An audible crackling or buzzing may be heard from a portable radio. This is the final warning—the lightning discharge process has started. Immediately drop to a kneeling or crouch position and crawl toward the safest place you can find. Remain down until the danger is past.

Most accidents involving lightning need not happen. With knowledge of lightning behavior, the awesome beauty of a thunderstorm and its dramatic lightning displays can be enjoyed with only minimal risk. But safety requires that we understand the phenomenon, plan ahead, be alert and observant and act decisively when action is required. These are useful instructions for any outdoor activity.■

Search for Sauger *continued*

"How many mature sauger did we catch today?" Paul asks.

"Only 17," I answer.

After stowing the tagging equipment, I grab a long-handled, basketlike net fitted with fine window screen and designed to catch fish eggs. I wade into the current and motion for Paul to wade upstream as I firmly plant the net on the bottom of the river. Paul vigorously swishes his feet along the river bed as he wades toward me, then jumps out of the way to avoid colliding with the basket as I sweep it out of the water.

The debris in the basket yields 18 walleye eggs.

"Wow! It's hard to believe those tiny eggs grow into walleye," Paul exclaims. "Considering the small portion of the river we sampled, there must be millions of eggs here."

"Walleye eggs range from 1.8 to 2.3 millimeters in diameter," I reply. "But sauger eggs are even smaller, 1.4 to 1.9 millimeters. During the last three years, I have measured the diameters of the eggs collected downstream from the Intake diversion and estimated that over 90% were from walleye and 10% or less from sauger.

"Is it an advantage for fish to have such small eggs?" Paul asks.

"If the eggs are small, more can be produced per female," I reply. "Neither walleye nor sauger prepare a nest or depression in the stream bottom before spawning, nor do they provide parental care while the eggs are incubating. Instead, they simply scatter their eggs across the substrate where they are subjected to many environmental hazards. So, many eggs are needed to assure a sufficient hatch."

"Two and one-half feet deep, 2.4 feet per second, loose cobbles," Paul calls out as he measures the depth, stream velocity and determines the substrate at the egg sample site. "How do these measurements relate to spawning?" Paul asks.

"Well, even though walleye and sauger scatter their eggs, they still require a specific habitat before they will spawn. From these measurements in the Yellowstone, we can determine what flows are necessary to maintain this spawning habitat," I reply.

"Well, I'm about ready for dinner," Paul says. I nod agreement and watch the small puffy clouds reflect the pinkish rays of the setting sun.

The next morning I watch a large flock of white pelicans enjoy the warm sunshine. They are fishing a backwater 20 miles downstream from Intake Dam, each rhythmically plunging its huge bill into the water. The cottonwood forest frames the scene in green, evidence that spring has arrived.

"I bet we find a school of walleye over there," Paul exclaims, pointing to a run near the head of the dry side channel. True to Paul's prediction, walleye ranging from 1.5 to 5 pounds flash to the electrodes. When the electrodes no longer attract any walleye, I turn the boat upstream and beach it near where we collected the most fish. We have now located eight walleye spawning sites and identifying their habitat—moderately flowing current over clean gravel bars—is becoming easier. Mature sauger are still scarce and the ones we collect, particularly males, are associated with groups of walleye.

"Only 15 miles to Sidney," I call to Paul as he shoves the boat out.

"I don't understand why we didn't see other boats on our trip. Even near the cities we didn't see any," Paul wonders aloud.

"I don't know. Maybe it's because people usually don't know what's in their own backyards," I reply.

"Maybe we can help," Paul says.

"Yes, maybe," I echo. We listen to the twilight noises: a crowing pheasant, the slamming of railroad cars, the raucous quacking of several mallards, the distant whining of huge truck tires on the highway, the honking of geese from a nearby gravel bar, car horns sounding and the snorting of a surprised whitetail. We find an adequate spot to spend the night, and sleep comes easily to both of us.

There's the bridge," Paul exclaims, as a majestic old railroad drawbridge comes into full view 'round the bend. The morning has dawned warm and sunny.

"Yahoo!" I yell, venting some of the emotion and excitement of our journey and also anticipating our return back home to Miles City.

The last leg of the float was like no other stretch of river. The channel had widened, deepened and was bordered by steep banks. At times, the current was almost imperceptible. The river bars were no longer gravel but of fine sand and silt. We located only two more walleye spawning sites where a stronger current was present. Adult sauger were still not numerous.

As we drive the 170 miles back to Miles City, events of our trip race through my mind—the small number of mature sauger, the large number of walleye, the rainbow smelt incident.

"Look!" Paul exclaims as we drive over the Tongue River bridge. To my dismay, I see that the flow in the Tongue is now a trickle.

"What happened to all the water in the Tongue?" I ask as I hurry into the regional DFWP office.

"Well, first, we have had a drought since last July; second, the irrigators have opened their ditches early since it's so dry, and third, since flows are so low, the Department of Natural Resources and Conservation closed the Tongue River Dam to do emergency repairs," answers Al Elser, the department's fisheries manager for the Miles City region. "An unlikely set of circumstances caused the low flows," he adds, "but the flow you see now is more than what has been allocated for instream flows."

"What can be done about increasing flows in the Tongue? What will happen to the sauger?" Paul asks.

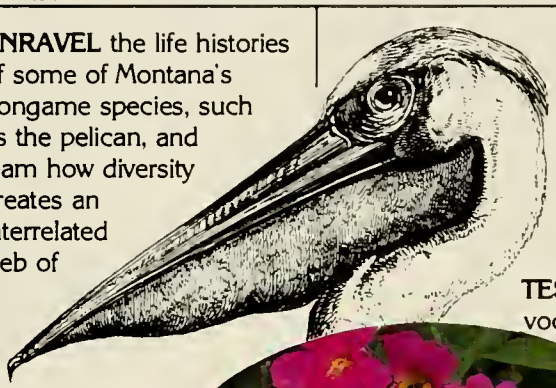
"It may be too late to help the sauger this year," I reply. "The sauger were in the middle of their spawning activities and the sudden drop in water probably caused them to return to the Yellowstone River. The reduced flows may already have exposed their eggs to the air. The year 1980 will probably be a very poor one for sauger reproduction. The sauger population can probably withstand one or two years with poor reproductive success. But if low flows with ensuing poor reproduction become the norm, the population may be threatened with extinction. Fishermen three years from now will undoubtedly feel the effects of low flows in the Tongue River during 1980."

"Adequate flows in the lower Tongue River during spring are essential," adds Al. "Fishery needs must be considered in any development of the Tongue River Dam and the allocation of its waters."■

Got a houseful of relatives this summer? Give 'em a bit of Montana to take home with a subscription to MONTANA OUTDOORS!

WIDEN YOUR CIRCLE OF FRIENDS

UNRAVEL the life histories of some of Montana's nongame species, such as the pelican, and learn how diversity creates an interrelated web of



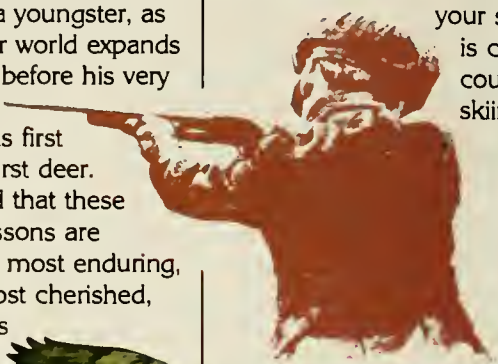
living creatures. **DISCOVER** the fascination that mushrooms hold.

The location of prize morels such as the one pictured, is as carefully guarded as an old family recipe, and every bit as valuable. **THRILL** to the freshness of sun and the exhilaration of spray as you enjoy a day of sailing across one of Montana's many lakes or reservoirs.

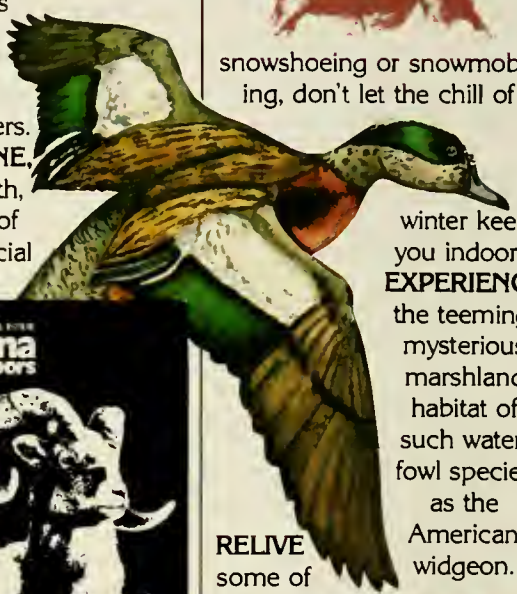
TEST your vocabulary of adjectives by attempting to describe some of the state's superbly beautiful wildflowers, such as the red monkeyflower. From delicate yellow or pink to deeper tones of blue and purple, Montana's delicate wildflowers offer a paintbox of color. **RELAX** by a farm pond and spend the afternoon fishing for

pumpkinseed—or sunfish, as they might be called locally. **SHARE** and grow with a youngster, as the outdoor world expands and grows before his very eyes. His first fish. His first duck. His first deer. Understand that these outdoor lessons are among the most enduring, and the most cherished, that parents can pass along to sons or daughters. **EXAMINE**, in depth, some of the special

issues facing Montana. The reality of a free-flowing Yellowstone, the range of recreational opportunities offered by the state's park system, the threats that the sport of hunting, as we know it today, faces. **SAVOR** the silences and soft noises of a Montana winter. Whether your sport is cross-country skiing,



snowshoeing or snowmobiling, don't let the chill of winter keep you indoors. **EXPERIENCE** the teeming, mysterious marshland habitat of such waterfowl species as the American widgeon.



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Readers Respond

Whose Fault Is It?

Many people wonder why, when they take a Sunday trip into the country or mountains, all the people who live there are so selfish. They find ideal picnic and camp spots are surrounded with "No Trespassing" signs, roads are marked "Private" and "No Hunting" and "No Fishing" signs are everywhere. These country people aren't selfish; they are tired of trusting people.

I have yet to discuss littering, vandalism and general disregard for a property owner's rights and feelings with anyone but what they swear avidly that they are very careful about such things, that they often "clean up the other guy's mess" and would never be guilty of such a thing.

Absolutely nobody is guilty when you talk to them. But water tanks, signs, windows, equipment and a host of other things are shot full of bullet holes. Bottles are used for target practice and the glass is left lying on the ground. Bullet-riddled beer, food and pop cans are strewn everywhere—all by these innocent people. Livestock are shot and, either by accident or design, so are chipmunks, squirrels, birds and other small wild animals. Gates are left open, causing the landowner a lot of needless grief and hard work setting things in order again and putting his livestock back where they belong. Fields and grassy hillsides are left rutted and scarred from off-road vehicles—all by these innocent people.

The nice-looking picnic and camp spots have been left with trees cut and other trees are marred with initials and slogans. Rocks and buildings have been painted with names, slogans and obscene words. Plastic and foil containers and empty cans, bottles and other items are strewn around on the ground or they are tossed into the creek. Many people figure if it floats down a creek out of sight, they have left the place clean. Others believe that if they hide their trash behind a rock or log, or pile it all in a campfire ring and burn the labels off the cans and bottles, they have fulfilled their obligation.

Some feel that anything left unattended—buildings, equipment and other objects—is fair game for destruction, stripping for parts or materials or hauling home.

You might be one of the people really and truly innocent of any of these things. But how does the landowner separate you from the others? It gains him absolutely nothing to let people use his land. As it sits, it is clean, intact and as he left it; if nobody goes on it, it will remain that way and he will be spared loss, grief, worry and a lot of extra work.

So think about it carefully when you drive along a country road lined with "No Trespassing" signs. Whose fault is it? And what would you do if you were the landowner?—*Carl Art Rowland; Basin, Mont.*

Use Common Sense

I was nearly ready to cancel my subscription until I saw your article, "Return of the Trapper" (Jan./Feb. 1981). Until this story, it seemed every article was about a conservationist trying to protect this or that.

I have done quite a lot of trapping and it is a great sport. Just be sure you use that right sized trap according to what you're trapping, and make sure you check your traps often.

In my opinion, trapping is more humane than slaughterhouses. Many people who condemn trapping think nothing of eating a beef steak every night.

The same thing applies to catch and release fishing. How do they know a fish doesn't feel the hook? The best thing to do is catch your limit and go home.

I was born and raised in western Montana. My granddad came there in 1900 when there was very little game. The logging and clearing of the land helped bring game in.

We shouldn't lock up the land, but use it with common sense, and these fine sports such as hunting, fishing and trapping will be around for many years to enjoy.—*Richard R. Weare; Palmer, Alaska*

Two Unusual Catches

My son Dave was fishing in the Missouri River this last spring, about two miles below Canyon Ferry Dam. He was using a brass Mepps #2 spinner and hooked into what proved to be a 4½-pound female brown trout. When he cleaned it, he checked the stomach contents and found 11 fingerling trout, ranging from five to six inches long. He decided they were rainbow and brook trout. It would appear he was in violation of the "10 fish or 10 pounds" regulation! At least he had the thrill of catching 12 fish on one hook (or lure) all at the same time.

The story above is in itself odd, but the following tale is perhaps even more strange.

Two years ago, also in the spring, Dave was fishing the Boulder River south of Boulder. He was using a brass Colorado spinner rigged up with worms as a trailer. He hooked a brown trout (male) and it weighed about three pounds. When he cleaned it, he found two gophers, each about nine inches long, in its stomach. I sometimes wonder what he will catch next!

Thank you for the fine job on *Montana Outdoors*. I have enjoyed it for many years as have many of my friends.—*Warren H. Robinson; Boulder, Mont.*

Can't Get Along Without It

A good friend who now lives in Billings gave us a subscription to *Montana Outdoors* three years ago. I see we just got our last issue. But now we enjoy it so much, we can't get along without it, even if we never get to Montana.

Thanks so much for all the pleasure.—*Lawrence Wingert; Sioux City, Iowa*

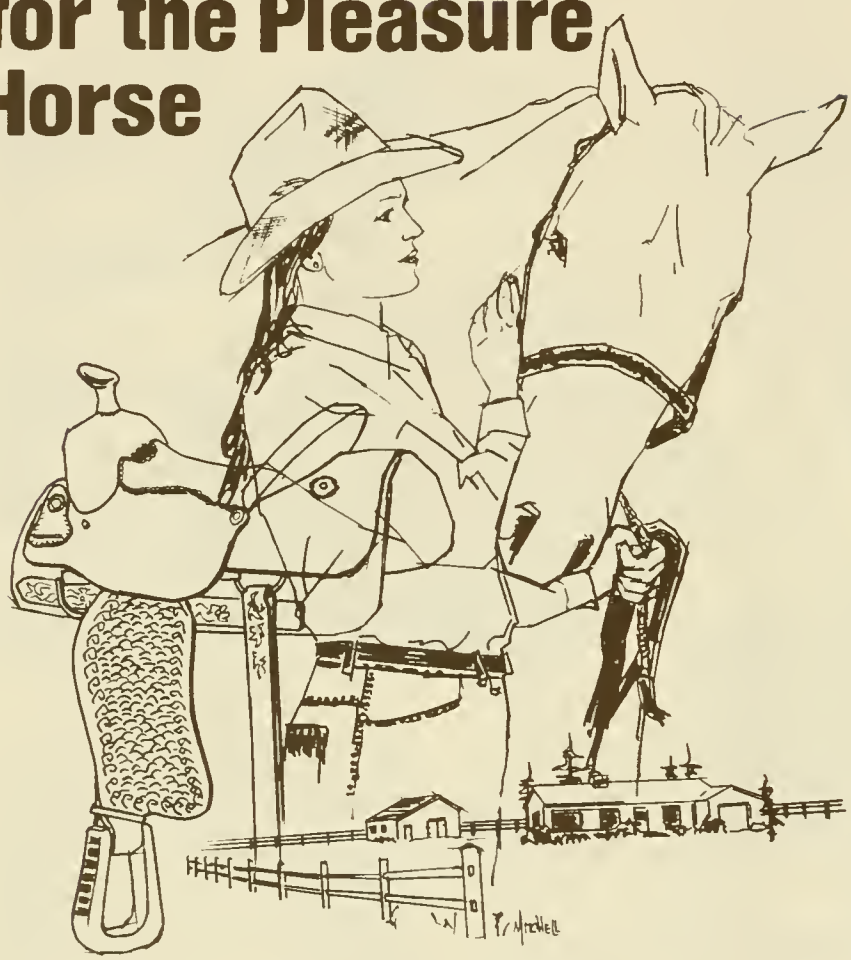
Keep Up the Quality

I have enjoyed your magazine for a number of years, and I hope you can keep up the quality. It has been some years since I visited Montana, but I was especially interested in your article on the protection of the grizzly bears that you still have. We here in Colorado unfortunately have none, although the fact that we have many streams named Grizzly Creek and such indicates there were grizzlies along the creeks at the turn of the century.

I am not an environmentalist, but an engineer who realizes we will have to develop our resources here in Colorado to take care of our national needs. But I am in hopes that we can do it without interfering with our wildlife too much.—*Marcellus Merrill, Merrill Engineering Laboratories; Englewood, Colo.*

RECYCLED PAPER

Preserving a Place for the Pleasure Horse



by David G. Conklin and G. Wesley Burnett
graphics by Mitchell Paulson

"...In or near town with at least two bedrooms and one bath...." the real estate agent repeated back to me over the phone. "No, a house for a small family shouldn't be hard to find. Anything else?"

"Oh yes," I said, "We also need a barn, stable and pasture for three horses." I held my breath anticipating the click at the other end of the line from another frustrated real estate agent unable to help.

Our move to Miles City, "The Cow Capital of the World," was finally completed after purchasing a house and property specifically designed for horse owners. But it brought home to us the reality that many Montana communities are rapidly becoming urbanized, and that keeping horses in or near them is growing more and more difficult.

Despite the problems and the expense, however, recreational horse ownership is growing in Montana and throughout the nation. If present trends hold, there will be more than 25 million horses in the United States by the year 2000—more than at any time in history. Even more amazing is the prediction that 80% to 90% of these horses will be kept in urban and suburban areas for recreational use!

Why do city dwellers commit themselves to the expense and responsibility of owning such an utterly uneconomical animal as a horse? The answers are not clearly understood, even by psychologists. Perhaps part of the explanation dates back 4,000 years, when someone, somewhere threw a leg over a horse and rode—and was stirred by the exhilaration and thrill of becoming one with a beast whose strength was many times his own. The mutually dependent, mutually rewarding relationship between horse and rider is a sensation missing from many other forms of outdoor recreation. While large and strong enough to be extremely dangerous, the trained horse is also a responsive, "feeling" creature capable of transmitting a sense of power, mastery and mobility to the horseman. The risks and rewards of horsemanship, and the full physical and mental concentration it demands, may be especially appealing to many middle-income city dwellers, whose sedentary, unchallenging lifestyles in the midst of cold, uncaring machinery, noise and pollution drive them to seek simpler, more natural, experiences in the suburbs.

Whatever the reasons, many city dwelling Americans are willing to pay dearly for the privilege of horse ownership. Although it varies considerably by locale and individual circumstances, the initial investment, according to a recent article in *Business Weekly,* includes $500 to $1,500 for the horse and another $500 to $2,000 for equipment. This initial investment is followed annually by another $900 to $2,500 for "keep." In 1978, the cumulative effect of these investments, according to geographer Charles O. Collins, was a $15 billion industry with the value of and trade in the horse itself contributing only $1 billion of the total. Ironically, a major part of this industry consists of producing vehicles designed to lend mobility to the horseman and horse. As Collins observed, "Many pleasure horses appear to be more hauled than ridden!"

While the costs of owning and maintaining a suburban horse at first glance may seem prohibitive, they are quite similar both initially and in the long run to those associated with many popular recreational activities, such as boating or trailer camping. A boat or trailer, however, may be used only seasonally, while a horse must receive constant care and attention. In fact, the problem of health—that of the horses *and* the people who live nearby—has become a matter of increasing concern to city and county administrators, public health officials, conservationists and humanitarians.

Due to stringent regulations and high expenses, the horse owner is often hard pressed to make ends meet and may be tempted to make compromises. For

example, adequate fencing is costly. The comparatively inexpensive electric, barbed or woven wire fence, which would adequately restrain a horse on a large acreage, may be inadequate for a bored and restless one kept on a small urban lot. The novice horseman, unaccustomed to a bored horse's aptitude for breaking fences, may try to cut fencing costs, only to learn that such a compromise too often results in a vagrant horse which neighbors, motorists, urban administrators, the police and sometimes the courts do not appreciate. These factors may also create complex insurance and liability problems for the horseman, which may be made even worse when the novice is led by enthusiasm or an unscrupulous dealer to acquire "more horse" than he is able to manage.

Horses must also be fed and exercised. For the suburban horse boarded out in a stable, feed is normally part of the stable's fee. The minimum acceptable acreage for pasturing a suburban horse has been much debated, but most experts agree that an acre to two acres is sufficient, provided the rainfall is adequate, the soil good, the horse substantially fed rather than pastured and the owner willing to devote considerable energy to intensive management of his pasture. To the extent that these conditions are not met, the necessary acreage increases dramatically.

Yet, again often due to the cost of land, many suburban horses are maintained on lots so small that proper grazing management is impossible. Consequently, overgrazing of suburban pastures is a serious problem.

Control and disposal of wastes is also imperative. Parasites are transmitted to horses through contact with manure and some diseases may be transmitted to humans; also, the odor of a poorly kept horse lot is not a welcome addition to any neighborhood. Various forms of composting may make waste products desirable to local gardeners and nurserymen, but composting requires extra effort.

Nationally, the suburban horse phenomenon and reaction to it appears to follow a pattern. The horse owner buys a homesite on the outer edge of the suburbs where he can keep and ride a horse. Planners and administrators tend to view the horseman's presence at this time with indifference, believing that he will move out of the way of "progress" when the time comes. In the meantime, these horse owners ride on oblivious to the rapid changes around them—street improvements, traffic congestion, new homes and new commercial developments.

Eventually new taxes are levied, restrictive zoning is implemented and public health regulations are changed. A battle ensues, probably several battles. Who wins is beside the point—the pleasure of horse ownership, once so satisfying on the suburban plot, is no more. In a sense, the horse has been "planned" out of existence through official indifference to the reality of the suburban horse and the horse owner's acceptance of this indifference.

There is one new and highly innovative solution to the suburban horse problem: Housing developments that cater to horse owners. It originated in California (which has the greatest number of horse owners in the nation) in response to zoning regulations that require lots so large as to be prohibitively expensive. In this new approach, the developer focuses the entire theme of the housing development, from name to street pattern, on the horses. This includes such amenities as communal stables, indoor and outdoor riding arenas, spectator seating, bridle paths and often access to public trails.

One such subdivision is "The Trails" at Rancho Bernardo in the suburbs north of San Diego. The product of Avco Community Developers, "The Trails" made land attractive to horse owners in an area where zoning required lots at least one acre in size (resulting in a finished price of $32,000 or more). Supplied with seven miles of bridle trails, a saddle club and a three-ring arena with a seating capacity of 600, 54 lots had been marketed by 1976 at an average price of $37,000. Purchasers were business and professional people, many planning retirement at "The Trails."

Saddle Hill Ranch in Orange, California is another example of an attempt to make horse ownership attractive in a strictly zoned suburban area. With 35 homes on 45 acres, Saddle Hill includes a community stable, riding arena and several miles of trails. Homes in 1976 were selling for $132,000 to $165,000. Each lot is limited to five horses, although most residents board their horses in the community stables and only occasionally on their home lots.

"The Country," a portion of the planned community of Diamond Bar in Los Angeles County, is an even more ambitious project. Consisting of 714 homesites on 1,200 acres, it includes a 14-acre "equestrian center" and 90 miles of trails. Horses are limited to three per half-acre. With lots ranging from $14,000 to $30,000 and homes selling for about $107,000 in 1976, it is interesting to note that only a third of the purchasers were horse owners. The remaining two-thirds simply enjoyed the pastoral charm of horses and riders.

" ...often due to the cost of land, many suburban horses are maintained on lots so small that proper grazing management is impossible. Consequently, overgrazing of suburban pastures is a serious problem."

While planned developments such as these are becoming increasingly common in the suburbs of major metropolitan areas, they are probably decades away in Montana. Still, Montanans have reason to be concerned. Although there are no exact statistics on the number of recreational horses in Montana, a survey conducted in July, 1976 by the Montana Department of Fish, Wildlife and Parks suggests that this use is significant. Adults participated in more than 103,000 recreational rides on trails in 1976 and more than 150,000 rides in off-trail locales such as suburbs. Previous work by the department also indicates that participation is greater in the spring and autumn than in the summer.

Recreational use of horses in Montana roughly equals participation in such popular activities as river floating, backpacking and cross-country skiing. In addition, each year races, rodeos, gymkhanas or O-Mok-See (barrel racing, pole bending, etc.) attract thousands of spectators. Of course, horses are used extensively for backcountry and wilderness travel in Montana.

Although exact figures are not available, the frequent use of horses in or near many of Montana's largest cities suggests that a sizable number of horses are kept in suburban settings. Such observations are verified by realtors who indicate that many purchasers of rural lots select them with horse ownership in mind. Similarly, the frequency of complaints from suburban areas concerning unconfined or abused horses and improperly managed waste

material is also on the rise.

These factors suggest that Montana's traditionally free-and-easy attitude toward horses cannot long survive in an increasingly urbanized environment. However, urban expansion need not spell doom to horse owners in urban and suburban settings. The California examples have demonstrated that under planned conditions horse ownership can survive urbanization and even become an integral part of the suburban environment. With the proper controls, horses can be kept in residential areas; open spaces and green belts can be designed with horses in mind, lending a pastoral charm to city living reminiscent of an America we fondly remember. Whether this will happen in Montana will depend on the foresight of Montana's horsemen and their ability to cultivate an awareness among public officials.

Numerous recreational horse groups in Montana are helping to develop the skills and abilities of their members, as well as to educate the public about the special rewards and problems associated with horse ownership. Unfortunately, novice horsemen, who are the ones most likely to offend the public through ignorance or lack of ability, often lack the time or money to join these groups. The education of the novice is the concern of every serious horseman, because anyone who neglects or abuses a horse is a threat to the rights and privileges of other horsemen. Other groups of recreationists, including hunters, snowmobilers and boaters, have long since learned the importance of self-policing and educating their members through formal programs.

While there are currently many groups with which the horse enthusiast may affiliate, most of them focus on a particular breed of horse or form of riding or competition. Few, if any, organizations have been formed to foster an awareness of the recreational horse's place in society or of the impact of public policy on horse ownership. The successful conversion of the horse from an economic necessity to a recreational animal has been, and will continue to be, dependent on horsemen with diverse interests identifying a common goal and expressing their desires in the political arena.

Over the last 4,000 years, the horse has influenced our dress, religion, social organization, politics, architecture, town planning and communication. From the Greek symbols of Pegasus and the Centaur to the modern word "horsepower," the horse has exerted a silent but potent influence on our lives.

The trends in horse ownership are unmistakable in Montana, as they are elsewhere in the United States. All signs indicate that horse ownership will increase more rapidly in the future than it has up to now. It is not a passing fancy but a permanent and growing recreational land use which should be planned for. Montana's public officials and horsemens' organizations must recognize the special problems associated with horse ownership if we are to successfully integrate the recreational horse into our growing communities and changing lifestyles.■

Book Reviews

PHOTOGRAPHING THE WEST, A STATE-BY-STATE GUIDE, by Erwin and Peggy Bauer, Northland Press, P.O. Box N, Flagstaff, AZ 86002; 1980, 204 pages, hardbound, $27.50; softbound, $14.95.

The Bauers have put together a remarkable guidebook to what, in their words, is perhaps "the most photographable region left on the face of the earth." It not only contains more than 100 excellent wildlife and scenic photos of western North America (including Alaska and Hawaii), but it also tells when, where and how to take such photographs yourself.

The book is divided into three parts. Part one offers an informative discussion of equipment and techniques for outdoor photography; part two contains a selection of color photos that illustrate various subject categories, such as mountains, wildflowers and birds; and part three contains detailed information on the national parks, national wildlife refuges, state parks, preserves and sanctuaries in each state, including the best times to go, special wildlife found in the region, addresses and accessibility.

All in all, the book is an extremely useful guide for anyone planning a photo safari in the American West.

FISHING THE HEADWATERS OF THE MISSOURI, by Norman Strung, Mountain Press, P.O. Box 2399, Missoula, MT 59806, 1980, 174 pages, $6.95, paperback.

The vast Missouri River drainage above Canyon Ferry Reservoir represents perhaps the most important wild trout resource in the United States, and Norm Strung has obviously thoroughly explored its fishing opportunities. This is the drainage of such famous rivers as the Big Hole, the Beaverhead, the Madison and the Gallatin. Strung also includes the Yellowstone River and takes the reader down them all on an all-seasons, personally guided fishing trip. It is not all fishing either, for Strung appreciates the beauty of these magnificent rivers. The information in this book comes from long years of personal experience and is thus of extreme value to the fisherman setting out to explore this drainage of troutly delights. There are tips and hints for the float fisherman and bank fisherman, whether he or she fishes with flies, lures or bait.

Float fishermen in particular will find this book helpful. Strung knows the access points on the rivers and warns the reader of the hazards and difficulties on each reach of the river. He also lists the approximate float times from access points on the various rivers. Novice floaters should inquire locally, however, before floating a river to learn of possible hazards since rivers can change annually. Strung includes an excellent map for each of the rivers and it lists access points for both float and bank fishermen.

Strung is aware of the fragile balance between landowners and sportsmen and his treatment of this important relationship should be taken to heart by the reader. Many of the fishing opportunities in the upper Missouri drainage are at the discretion of the landowner. Access in the future will depend, to a great extent, on the behavior of fishermen today.

It is noteworthy that Strung shares a great deal of his accumulated knowledge without revealing the specific "secret spots" that he and others of us have come to know through years of personal experience. This is particularly true in his treatment of the smaller streams and high mountain lakes of the region. He describes the angling and seasonal requirements for successfully fishing these streams and lakes but does not name them. Rather, he leaves it to the reader to discover them for himself. Trout fishing is, after all, an intensely personal experience.

Strung also has a knowledge of the biological factors limiting trout populations in the rivers of the upper Missouri drainage. The dewatering, sedimentation and thermal problems described by Strung are very real threats to wild trout populations in portions of our rivers.

"Fishing the Headwaters of the Missouri" is not a book that tells you where you can catch five-pound brown trout. It is better than that. It is a book for fishermen who wish to experience the joys of personally discovering this vast area of trout fishing. Strung shares his wealth of personal experience in angling techniques and knowledge of the area. The rest (and the best) is left up to the reader.—*Jerry Wells, fisheries biologist*

photo: Jerry Manley

SOCIAL CONFLICT ON THE MADISON

by Ron Marcoux

A river. And the opportunities it offers. Shall I take my son fishing? Maybe take the family on a picnic along its banks? Wouldn't tubing be fun? How about a scenic raft trip, or just floating along and fishing? Watching some water ouzels bob on a rock? Listening to Canada geese call? These are only a few of the possibilities that pass through the minds of thousands of Montanans every summer.

A river. From the sound of softly rushing water to the scenic panorama that unfolds around every bend, a river explodes with recreational opportunities. Whether it's a child skipping rocks, a duck hunter in an early morning blind or a raft full of friends riding the white water, the river holds very personal and individual meanings and challenges. Like the many clouds in the sky, the nearly endless and changing opportunities provided by a river reach out to us. As each one of us seeks his chosen opportunity on a river, we find it becomes difficult to be alone. On many rivers, we begin to share experiences, because the river's call has been heard by many. Solitude and quiet may be interrupted by laughter, and the scenery around the next bend may include other floaters. The more secrets of the river that unfold, the more people who go to the river to discover them.

A good example is the boom in floating. Whether by raft, kayak, canoe, Mackenzie or johnboat, each person has a chance to view the river differently. Standing on the bank, the river flows by. But in a boat, you see and feel different aspects of the river. You can feel the surge of the white water rapids; you can hear the otter call as he floats nearby, or watch a mink sneaking along the river bank. You also pass other river users and become part of their experience—whether it's a welcome part of your experience or not.

An example of a river well known as a trout fishery and one that provides both fishing and scenic

enjoyment to thousands every year is Montana's Madison River. This "blue ribbon" trout water has been acclaimed by articles in nearly every outdoor publication, and her fishing reputation is hardly a secret. The fact that many people use the river speaks highly of its importance, but the *way* people perceive their river experience has created considerable controversy—some warranted, some not so clearly defined.

If you go to one of the popular boat launching sites on the Madison during the famous "salmonfly" hatch in July, you may have to stand in line for 45 minutes in order to launch your boat. If you were a bank fisherman fishing in a single pool, studies have shown that more than 60 boats could pass you in an eight-hour period. It's common to see float fishing craft above, below and even on the opposite side of you as you fish this great river.

In the late 1970s, the Department of Fish, Wildlife and Parks conducted meetings so interested persons could discuss restrictive fishing regulations brought on by this heavy pressure. The issue mushroomed into controversy—not on the need to restrict the number of fish caught, but on the need to restrict boats on the upper Madison.

Participants cited many reasons for boats causing problems: They helped catch too many fish; they allowed fishing in areas that bank fishermen couldn't reach; they went through your fishing hole and dispersed the fish; people in boats weren't courteous; since the river could be waded anyhow, boats weren't needed in order to catch fish. Some of the floaters said their experience was compromised by too many boats.

On the upper river, nearly three of every four boats were commercially guided in 1980. The idea that commercialization was destroying the river was also voiced, even from people in communities which benefited from the guiding activities.

Some of the complaints were valid; others were only half of a two-sided coin. For example, float fishermen were primarily catch and release fishermen; on a given stretch of river, the actual number of fish harvested by them was less than their bank fishermen counterparts. Most floaters, particularly the guides, are courteous since they are trying to provide an enjoyable experience to their clients, not confrontation. The issue boils down to a *social,* not a biological, conflict. More restrictive fishing regulations can be imposed to deal with biological issues. But boat regulation and the accompanying social implications is a new area.

The Fish and Game Commission has authority to restrict "float fishing" in areas of high use by bank fishermen. This approach has been used on portions of the Madison where bank access is readily available to try to minimize conflicts between float and bank fishermen and to give each a chance to fish without unduly interfering with the other's experience. Although this approach appears very reasonable, conflicts still arise when boats transport fishermen from hole to hole.

In reality, boat control options are few. The commission can regulate public boat use only where threats to public health, safety or protection of private property are involved. A bill passed by the 1981 Montana Legislature allows for possible moratoriums on new outfitters and guides on just the Madison and Big Hole rivers. A survey compiled as part of a 1980 moratorium on new outfitters and guides on the upper Madison River found over 45 outfitters and 90 guides qualified to use the river. This sort of moratorium is not a way to reduce use. Realistically, we can expect use to increase both from the public as well as from the outfitters section since all qualified outfitters and guides are not currently on the river every day.

What are some other possible answers? (1) Let river use control itself. If there are too many boats, users would look for another river to float. (2) Curtail *all* float fishing, or do so during high conflict periods. (3) Limit the number of outfitters and guides. But as public use increases, the outfitter or guide could rightfully argue that you're right back where you started. (4) Employ a lottery system that allows only so many boats on a given section of river. (5) Educate boaters to improve their ethics and thus minimize confrontations with other users.

Answers don't come easily, because we are dealing with many individual attitudes and economic impacts. One also wonders if we fully understand the root of the controversy. Perhaps additional study could better identify the real conflicts before controls are contemplated. This could help minimize the threat of overregulation.

In overview, we have to go back to the river and the experiences it provides. The Madison, like the Big Hole, Yellowstone and Beaverhead, will continue to grow in popularity because it has the attributes that fishermen and other recreationists seek. As these users multiply, we can expect more clashes to occur between interest groups, each with a different perception of the resource and the experiences he expects to derive from it. With the exception of the Madison —by far the most heavily used river in Montana—we still have time to think about what we expect of our rivers, and what future controls may be necessary to enhance the opportunities for the many recreational users who derive a myriad of experiences from them.■

Wildlife Shorts

The bite of most spiders is harmless to humans. Even the large American tarantulas cause no more injury than a wasp.

* * * * *

Strange as it may seem there are no amphibians found in salt water.

* * * * *

With the energy crunch, how about raising oil beetles? These beetles, when disturbed, emit an oily liquid from the joints of their legs.

* * * * *

The oldest known skeletons of man date back about 1,759,000 years to about the beginning of the Pleistocene.

* * * * *

The whooping crane is the tallest North American bird.

* * * * *

Have you ever heard someone say you have goose flesh? This occurs when the papillae of the skin become erect due to cold or fear.—*Vince Yannone, youth educator, Conservation Education Division*

Lewis and Clark Caverns and the CCC: WONDER UNDERGROUND

by Ken Karsmizki

Many of the improvements in Lewis and Clark Caverns were accomplished during the 1930s by the Civilian Conservation Corps (photo courtesy National Park Service).

MONTANA'S first state park—the spectacular Lewis and Clark Caverns State Park—is situated high in the mountains above the Jefferson River Canyon. The history of the caverns is fascinating, a story which involves federal, state and local government, as well as many private individuals interested in developing the caverns for tourism.

Visitors to the park today may not notice the many alterations which make a tour through the caverns possible. The hand-chiseled steps, enlarged passageways, railings and many other improvements resulted form work by the Civilian Conservation Corps (CCC) from 1935 to 1941.

The CCC was a works project established under President Franklin D. Roosevelt's New Deal. The CCC employed young men, generally under 23, to work on special conservation and resource projects for the federal government. This massive employment project was designed to take them off the streets, give them an opportunity to earn money in a depressed economy and, at the same time, benefit the country.

Since 1933, many people had been seeking assignment of the CCC to Montana to develop Lewis and Clark Caverns, which was then a National Monument. Although the caverns had been proclaimed a National Monument in 1908, the park had never officially opened. With the help of the CCC, safe and easy access would make it possible for the public to view one of Montana's most spectacular and unique resources. More important, such development would facilitate state rather than federal management of the site, and Montana's first state park would be born.

In May 1935, Gibson Taubert, an inspector for the National Park Service, arrived in Montana. His duty was to assign CCC camps to state park projects. While in Montana, he visited Lewis and Clark Caverns National Monument to evaluate it as a potential CCC project. Not having seen the caverns before, the inspector initially was "somewhat dubious as

to the value of the caves." But by the time he completed his tour, he was convinced that a CCC project at Lewis and Clark Caverns would be most worthwhile.

The day before Taubert inspected the caves, he had received authorization to place two new CCC camps in Montana. The inspector stated that "if assurance could be given that the state of Montana could carry on and administrate the area after it became a state park," he would see that a camp was placed there.

Administration of Lewis and Clark Caverns National Monument had been the responsibility of Yellowstone National Park officials. After more than 20 years without money to properly care for the park, the Yellowstone administrators welcomed the chance to transfer their responsibilities to the state. Since many Montanans believed it was a great opportunity to acquire the site, Gov. Frank Cooney applied for the transfer of Lewis and Clark Caverns to Montana for state park purposes.

Within two months, the Jefferson Valley News in Whitehall announced that "the first recruits for the Morrison Cave [a local name for Lewis and Clark Caverns] CCC camp arrived in Whitehall Sunday morning [July 7, 1935], and that afternoon located a camp at the LaHood Park, in Jefferson Canyon." These recruits were an advance group responsible for building living quarters for the group assigned to work on the caverns themselves. Work progressed rapidly, and by September the quarters were finished.

On Oct. 31, 1935, the Whitehall paper reported: "Full Quota of CCC Boys Move to Cavern Camp: 210 recruits hole in for winter." The men spent the next two days hiking through the park and inspecting the work planned for them. Many of the CCC enrollees preferred work inside the caverns rather than the various projects around the park.

One of the first projects was a general cleanup of the caverns. Tons of dirt, rock and animal waste had built up over the years. The odor of bat and rat guano was overpowering and rodent nests were tucked into every visible crack and crevice. Walls and formations were stained or discolored. Entrances to passages were partially blocked by rubble washed into the caverns, and rotting timber littered the interior. (The timber was the remains of stairs from an earlier attempt to privately develop the caverns for tourism. Dan Morrison, a local mining entrepreneur, built the stairs around 1905 and they had served hundreds of unofficial visitors since then.)

The CCC crews set to work rebuilding the bridges and stairs. They also rigged a conveyor from the top of the vertical shaft (or pit) to the entrance. Bucket by bucket, tons of debris were hauled out—rock, rotting wood, rats' nests and trash. Pack rats were trapped and removed. The walls were scrubbed to remove the smell and stains.

As the cleanup progressed, the men were becoming familiar with the underground setting, the poorly lit working conditions and the danger inherent in cave work. One of the men, a new recruit by the name of Norfleet Fitzpatrick, was cleaning a wall at the top of the pit. Either he leaned too far over the railing or he dropped his head lamp; in any case, he overbalanced and fell over the rail and into the pit. He plunged over 50 feet before his fall was broken by the spiral stairway. Fitzpatrick was immediately rescued from the cave and rushed to a Butte hospital. His injuries were extensive, however, and he died a few days later.

The accident was unfortunate and could likely have been avoided. Nevertheless, it is a credit to the workers and their supervisors that only one serious accident happened in the thousands of man-hours expended on the caverns' underground development.

The men had uncovered many new passage openings while cleaning the cave and they were anxious to explore them. No one had systematically explored the caverns, and a reconnaissance could provide information for future development. A crew directed by William Glancy, who had previously worked at Carlsbad Caverns in New Mexico and Mammoth Cave in Kentucky, began the new, dangerous exploration.

The CCC monthly progress report for January 1936 noted that a new chamber (possibly the Wind Tunnel, the first section of which is Hell's Half Acre) had been found. The report continued: "At present it is necessary to crawl, snake fashion, for some 30 feet to enter this chamber. It is of an orange color and very impressive and different from all other chambers. It is located off the Cathedral Chamber, and at a point of great interest in the cave."

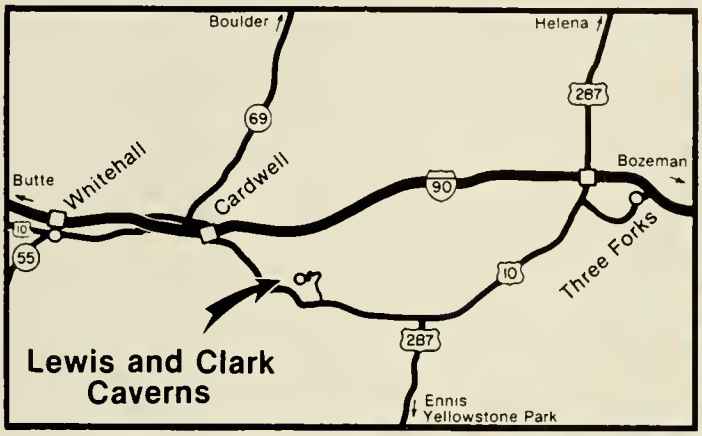
Within a few days, another discovery (Paradise Room) was reported by the Jefferson Valley News. The article stated: "The largest chamber yet discovered was opened by Mr. Glancy, Leaders [George] Cannon, and [George] Hamilton and a crew of 12 enrollees of the Company on Feb. 2. After hours of breaking and cleaning away the intertwining stalactites and stalagmites in a passageway discovered by Cannon, the crew found a chamber 200 by 500 feet, with a ceiling estimated at a hundred feet high."

Glancy's experience in other caves paid off as Lands End and the Bacon Room were added to the list of discoveries during the CCC period. One discovery, larger than the Paradise Room or Hell's Half Acre, provided the men with a harrowing experience. A description of the exploration from the 1930s relates that "this chamber was discovered when a curious worker crawled into it through a small opening. He withdrew, amazed, but later re-entered the room with Glancy and 10 other members of the crew. Once inside they wandered around for several hours before they found their way out again."

The men closed some of the newly discovered areas with rock or cement because of the danger of becoming hopelessly lost in them. Lands End, Bacon Room, Hell's Half Acre and this large room all appear to have been blocked off at one time or another. Hell's Half Acre was reopened in the 1950s, but others, including the largest, apparently remain hidden. (However, because of confusion in descriptions and discrepancies in some of the early records, some modern-day authorities on the caverns doubt that the largest room in the caverns still remains hidden.)

As one crew of CCC boys explored, another crew, directed by Bruno Petsch, began a preliminary survey. Petsch, a geologist, was temporarily assigned to the CCC camp in spring 1936 and he quickly trained a crew to help him in making a survey of the cave. Small, irregularly shaped passages, poor lighting and the need

Facilities at Montana's First State Park



Montana's first state park remains a valuable part of the state park system. The highlight of any visit to Lewis and Clark Caverns State Park is a guided tour through the caverns, but the park also provides a variety of above-ground experiences, as last year's 52,000 visitors can attest.

The park, containing nearly 2,800 acres, is 17 miles west of Three Forks on U.S. Highway 10. The caverns entrance, tucked away in a draw high up on Cave Mountain, overlooks the Jefferson River Canyon. This unobtrusive entrance masks the extent, beauty and variety of one of Montana's most significant natural attractions.

An Information Center marks the park entrance and contains interpretive displays which introduce visitors to the caverns. Just west of the Information Center, up the entrance road, is the nonreservation campground. Several times each week during the peak visitor season, park personnel present evening programs at the campground amphitheater. While visiting the caverns, school, church and civic organizations often picnic at the campground and participate in other outdoor activities.

Continuing up the park entrance road, one passes two shady picnic areas and a dramatic vista point overlooking the Jefferson River Valley. Both picnic spots have creeks running through them and both offer cozy, tree-lined alcoves for picnicking. The upper picnic area features a self-guided nature trail; a brochure available to visitors describes several species of forbs, shrubs and trees found along the trail.

DFWP photo: Brett Hamilton

At the end of the scenic three-mile drive is the Visitor Center where one can obtain information about tours and view the exhibits on the caverns' geology, history and ecology. A cafe and gift shop, operated by a private concessionnaire, is near the Visitor Center.

The park is now open and guided tours are available through Sept. 30. Tickets are available at the Visitor Center according to the following schedule: June 15 through Labor Day—9 a.m. to 7 p.m.; post-Labor Day through Sept. 30—9 a.m. to 5 p.m. Ticket rates are: adults—$2; children (6-12)—$1. A special rate of $1 per person is offered to groups of at least 15 persons making reservations two weeks in advance.

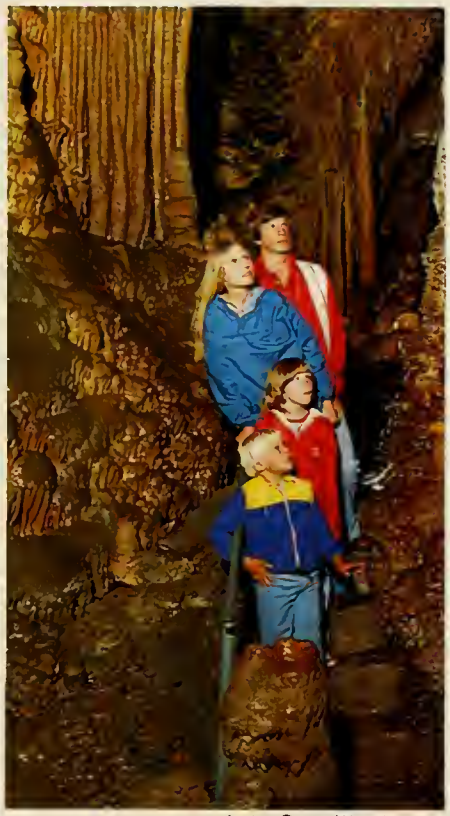


photo: Garry Wunderwald

Beginning at the entrance, a guide accompanies visitors on an interesting and informative tour which interprets caverns history and geology. Visitors are advised that stairways and paths in the cave are often wet and slippery and it is sometimes difficult to see until one's eyes become adjusted to the dim light. We recommend that visitors wear rubber-soled shoes and use the handrails; we also suggest visitors bring a jacket for the cool 50°F walk through the caverns. Including the walk to and from the caverns, the trip is about two miles long and takes from two to two and one-half hours to complete.

Recent improvements to aid visitors at the caverns include widening and resurfacing the tour exit trail, resurfacing worn stairs within the caverns and new, updated audio-visual programs at Information and Visitor centers.

Considering today's costs of travel, Lewis and Clark Caverns State Park may be the perfect option for a day's recreation. Few places can offer the combination of the caverns, picnic facilities, hiking trails and the chance to view some beautiful mountain scenery.—*Dave Todd, manager, Lewis and Clark Caverns State Park*

to sight survey lines from every possible angle made progress slow.

By the time the preliminary survey was completed, the men believed their discoveries had easily doubled the known size of the caverns. Permission was requested to undertake a more accurate survey the next winter. Their argument, convincingly enough, was that if they were permitted to continue the exploration and survey work, Lewis and Clark Caverns would "beyond probability surpass all other [caverns in the United States]" in size.

Glancy argued that it was then easily the third largest in the nation, behind only Carlsbad and Mammoth, and there was much yet to be explored. Further encouragement was given when a government consultant suggested that a new entrance at a lower level would be more convenient to visitors. It would result in greater use and thus would increase revenue. With this in mind, exploration and survey work continued.

Exploration and survey work were important and exciting, but the main goal of the work was to maintain a safe and easy flow of visitors with minimum damage to the natural features of the caverns. Building trails, stairs and guard rails and removing obstacles would enhance the experience for the thousands of visitors expected to view the cave.

At the same time, an important part of the CCC project was to preserve the natural beauty of the caverns. Advisors pointed out that "attempts to artificialize natural phenomena are not permitted in natural parks and...the atmosphere or 'feel' of a cave is better portrayed, where it is feasible, by following the natural cave contours, by the necessity of stooping occasionally, and of walking through narrow, natural passages."

The abundance of formations throughout the caverns presented an obvious problem in maneuvering, however. In many spots, it was necessary to chisel steps into the formations to provide a safe and easy way of getting over, around and through an area. Although some of the natural character was sacrificed, a system of trails allowed channeling people in specific directions, thereby preserving the majority of the caverns' features.

Time, money and an inability to solve all the problems of the caverns were limiting factors, but construction and trail-building proceeded steadily. The air in the caverns was a constant temperature of about 48-50°F and the easy way to stay warm was to work steadily. Even short breaks could become uncomfortable in the cool, dark, wet environment.

As construction work proceeded, the accurate survey that had been proposed earlier was also progressing. Howard Stewart, an engineer from Yellowstone National Park, was sent to initiate the new traverse. Stewart used a surface base line for control, extended his survey line throughout the caverns and placed permanent survey stations as inconspicuously as possible. Some of these markers are visible today to the visitor with a keen eye. A map was produced which delineated the basic features of the caverns and their relationships to surface features.

Continued exploration had not yielded the hoped-for lower entrance, but Stewart's map showed another possible solution. The Paradise Room was only about 500 feet inside the mountain wall. If a tunnel could be extended from the surface to the Paradise Room, it could take the place of a natural entrance.

The proposed tunnel could "provide an easy way out for visitors, thereby avoiding the rather tedious climb...traversed on the descent.... The comfort and convenience of the visitor is obviously important, but of far greater importance is the safety of those visiting the cave. This tunnel, therefore, will be of double value and serve two purposes in that it will afford an emergency escape way in case of fire or [the] possible...blocking

Tribute to Mel Smith

Since the days of the Civilian Conservation Corps, considerable additional work has been done at Lewis and Clark Caverns State Park, both inside and outside of the caverns. The outside work is obvious and, over the years, it has been accomplished by a number of people through a number of projects.

Work inside the caverns is not as obvious and that in itself is a tribute to the skill of the man responsible. The work is also extensive—ranging from completely replacing the original wooden staircases and steps with concrete and stone to driving two more tunnels through fragile areas and between rooms containing delicate formations, to adding to the original trail thus opening new rooms, to expansion of the lighting system, and repairing many delicate formations previously damaged.

This was accomplished with the sensitivity of a sculptor by a man with a will, the strength and the stamina to match the stones he worked and still loves. That man is former manager, Mel Smith, who was in charge at the caverns from 1949 to 1973. These things were often accomplished alone in "his cave" and with extremely limited finances and material resources. Some people know the extent of his dedication and his monumental effort because they helped with various phases of

Mel Smith (DFWP photo)

it. Others of us, he has shown. The real beneficiaries—the thousands who visit the caverns yearly—aren't aware that this man's hand has subtly made their presence and their comfort possible without detracting from the beauty around them.

It would be inappropriate to discuss the developmental history of Lewis and Clark Caverns without acknowledging, with our thanks, the tremendous efforts and accomplishments of Mel Smith.—*Don Hyyppa, assistant administrator, Parks Division*

[of] a passageway."

Work on the tunnel began in autumn 1938 and progressed rapidly. Glancy handled all the powder charges as the blasting into the Paradise Room began. John Stendel, one of the crew, related that a small-gauge rail line was constructed in the tunnel as they went, and handcars were used to haul the debris away.

As they neared the Paradise Room, the crew feared the final blast could damage the delicate formations. The crew decided to place the charges for the final blast on the inside and blow the rock out *toward* the tunnel rather than into the Paradise Room. The men prepared the surface, set the charges and then covered the inside wall with brush, old tires and other materials to absorb the shock of the blast. The exploding charge damaged a few formations hanging from the ceiling, but the plan had worked. There was no major damage—and there *was* a tunnel.

Those who planned the tunnel recognized that another entrance lower on the mountain would result in increased ventilation which would dry the cave and reduce growth of the formations. (Formations "grow" through a process of deposits left by dripping water. For more details, see "Lewis and Clark Caverns: A Showcase of Nature's Forces" in the March/April 1981 *Montana Outdoors*.) To reduce the air flow, two doors were hung, one at each end of the tunnel. In spite of this precaution, some drying has occurred.

By spring 1939, the underground work was nearly complete. One major problem remained—lighting the interior of the caverns. Funding the lighting project was no easy matter, however. It was expected that by July 1939 the stairways and trails would be ready for visitors and opening the caverns would provide money which could be reinvested in the caverns. Also, lighting needs could then be studied through actual use.

But the caverns were not opened until September. Response was overwhelming—more than 5,000 people tried to visit the new park within the first two months. Some had to be turned away, partially because of the lighting problem. At this time, the caverns were lighted by the visitors themselves—every fifth person was given a hand lamp to carry along the path. Large crowds could not be handled safely, and the spectacular formations were barely visible by the hand-held lamps. Unfortunately, the $1,500 taken at the gate the first season was not enough to pay for the proposed lighting system.

Shadan LaHood, a local merchant, had been instrumental in securing the CCC assignment to the caverns and provided land at LaHood Park for the camp barracks. In March 1940, LaHood wrote a bitter letter to U.S. Sen. James E. Murray. LaHood was upset about the possibility of the caverns project not being properly completed. He wrote that he believed Montana was entitled to a state park and, as yet, there was only half a park; all the previous work would have been in vain if the lights were not installed.

LaHood primarily blamed the caverns' problems on the Montana Legislature. The federal government had contributed nearly $200,000 to the caverns project. However, the state Legislature had not yet appropriated money to match the federal contribution. This had developed into a point of contention between federal and state officials.

The problem was further compounded by the fact that the upcoming budget (1941) for the CCC would be greatly reduced. Sen. Murray received word from the National Park Service that approval for extending CCC camps would be primarily based on the ability of the states to participate financially.

So, there was a critical need to obtain in-state money to complete the project. Walter R. "Barney" Rankin, the CCC supervisor of the caverns project, played a major role in a final funding push, as did Rutledge Parker, Kiwanis clubs and other concerned groups and individuals. (Parker was Montana's state forester in the mid-1920s and was a catalyst for the park movement in the state. He is often called the founder of Montana's state park system because of his work toward legislative support for outdoor recreation.) The Legislature received pressure for additional support to the parks program, and many credit the appearances of Rankin and the others before committees of the Montana House on behalf of the caverns as crucial to obtaining the funds.

Considerable public sentiment was stirred up and aid materialized. The State Park Commission, established in 1939, received authorization to assist the caverns project in the amount of $26,800. Montanans Incorporated, an organization of Montana Chambers of Commerce, offered $5,300 for material for lighting and other unfinished work. An additional $1,000 was transferred from unused funds at another abandoned CCC project.

The National Park Service acknowledged the efforts to secure necessary funding and supported completion of the caverns project. In July 1940, Rankin received a telegram from Sen. Burton K. Wheeler announcing that the CCC camp would remain at least until October of that year. The lighting system was finally installed, for the visitors' safety and to effectively illuminate the beautiful formations; a new gate was hung inside the entrance for security purposes; a few sets of stairs were replaced; some trails were rebuilt and surfaced, and additional handrails were placed.

Rankin left his post as superintendent for active duty in the military in February 1941. On May 2, 1941, the new supervisor, John Ballas, filed the final progress report, noting that the project had been completed and the CCC boys had moved out.

The Lewis and Clark Caverns State Park was scheduled to officially open on May 4, 1941. A thousand autos carrying more than 3,000 people reached the caverns on that soggy Sunday. Although the ceremonies had to be cancelled because of rain, many visitors took the ¾-mile hike up the hill for the caverns tour.

The CCC had taken pride in their six-year project and their feelings were appropriately stated in a souvenir booklet prepared for the dedication: "Though the visitor may enter the cave with a slight feeling of skepticism, he cannot help having a feeling of awe upon leaving—awe and humility at the wonders Nature displays even below the earth's surface. He will stand at the door of the exit tunnel with the weird beauty of the Paradise Room fresh in his mind and...be quite a little thankful for the Civilian Conservation Corps that made this beauty spot accessible to the general public."■

"I still don't know why I fish or why other men fish, except that we like it and it makes us think and feel. But I do know that if it were not for the strong, quick life of rivers, for their sparkle in the sunshine, for the cold grayness of them under rain and the feel of them about my legs as I set my feet hard down on rocks or sand or gravel, I should fish less often. A river is never quite silent; it can never, of its nature, be quite still; it is never quite the same from one day to the next. It has its own life and its own beauty, and the creatures it nourishes are alive and beautiful also. Perhaps fishing is, for me, only an excuse to be near rivers. If so, I'm glad I thought of it."

Roderick Haig-Brown
"A River Never Sleeps"